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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box PATENT APPLICATION
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Transmitted herewith for filing is the patent application of:

Inventor(s): Davis et al.

For: DATA TRANSMISSION BY WATERMARK PROXY

Enclosed are:

☒ 8 pages of specification, 4 pages of claims, an abstract, Combined Declaration and Power of Attorney (unsigned) and Appendices A, B and C.

☒ 2 sheet(s) of drawings.

		FILING FEE				Basic Fee
For	Claims filed	Number Alloted		Number Extra	Rate	$690.00
Total Claims	23	20	=	2	$18.00	$ 36.00
Independent Claims	3	3	=	0	$78.00	
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Respectfully submitted,

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METHODS AND SYSTEMS EMPLOYING DIGITAL WATERMARKING

60/134,782
5-19-99

Field of the Invention

The present invention relates to applications of digital watermarking in conjunction with audio, video, imagery, and other media content.

Background

Watermarking (or "digital watermarking") is a quickly growing field of endeavor, with several different approaches. The present assignee's work is reflected in U.S. Patents 5,841,978, 5,768,426, 5,748,783, 5,748,763, 5,745,604, 5,710,834, 5,636,292, 5,721,788, and laid-open PCT applications WO97/43736 and WO99/10837. Other work is illustrated by U.S. Patents 5,734,752, 5,646,997, 5,659,726, 5,664,018, 5,671,277, 5,687,191, 5,687,236, 5,689,587, 5,568,570, 5,572,247, 5,574,962, 5,579,124, 5,581,500, 5,613,004, 5,629,770, 5,461,426, 5,743,631, 5,488,664, 5,530,759,5,539,735, 4,943,973, 5,337,361, 5,404,160, 5,404,377, 5,315,098, 5,319,735, 5,337,362, 4,972,471, 5,161,210, 5,243,423, 5,091,966, 5,113,437, 4,939,515, 5,374,976, 4,855,827, 4,876,617, 4,939,515, 4,963,998, 4,969,041, and published foreign applications WO 98/02864, EP 822,550, WO 97/39410, WO 96/36163, GB 2,196,167, EP 777,197, EP 736,860, EP 705,025, EP 766,468, EP 782,322, WO 95/20291, WO 96/26494, WO 96/36935, WO 96/42151, WO 97/22206, WO 97/26733.

Most of the work in watermarking, however, is not in the patent literature but rather in published research. In addition to the patentees of the foregoing patents, some of the other workers in this field (whose watermark-related writings can by found by an author search in the INSPEC database) include I. Pitas, Eckhard Koch, Jian Zhao, Norishige Morimoto, Laurence Boney, Kineo Matsui, A.Z. Tirkel, Fred Mintzer, B. Macq, Ahmed H. Tewfik, Frederic Jordan, Naohisa Komatsu, and Lawrence O'Gorman.

The artisan is assumed to be familiar with the foregoing prior art.

In the present disclosure it should be understood that references to watermarking encompass not only the assignee's watermarking technology, but can likewise be practiced with any other watermarking technology, such as those indicated above.

Watermarking has various uses, but the present specification details several new uses that provide functionality and features not previously available.

Brief Description of the Drawings

Fig. 1 is a diagram showing the participants, and channels, involved in the distribution of music.

Fig. 2 shows a conceptual model of how music artists, record labels, and E-Music distributors can all interact with a Media Asset Management System, of which several are detailed in the following specification.

Detailed Description

For expository convenience, much of the following discussion focuses on music, but the same principles and techniques are largely or wholly applicable to other source data, whether non-music audio, video, still imagery, printed materials, etc.

Music Asset Management

Referring to the figures, the music distribution process begins with a creative artist 10. The artist's music has traditionally been distributed by a record label 12. (While the following discussion refers to distribution through such a label, it should be understood that such distribution can just as well be effected directed under the artist's control, without a record label intermediary.)

In traditional distribution 14, the record label produces tangible media, such as records, tapes, videos (e.g. music videos), and CDs 16. These media are physically distributed to end-consumers 18. Additionally, the label 12 distributes the music media to outlets 20, such as radio and TV stations, cable and satellite systems, etc., which broadcast (or narrowcast) the artist's work to an audience. Distribution through such media outlets may be monitored by playout tracking services. Playout tracking data, collected by firms including Arbitron, Nielsen, ASCAP, BMI, etc., can be used to compute royalty payments, to verify broadcast (e.g. for advertising), etc.

Increasingly, the distribution of the music to the media outlets is performed electronically. Such distribution first took the form of analog audio over high quality landlines or satellite channels. Digital audio quickly supplanted analog audio in such distribution channels due to higher fidelity.

More recently, distribution of the music from the record labels to the media outlets has occurred over secure links, now including the internet. Such security was first provided simply by scrambling the audio signal or data. More sophisticated "container"-based systems are now coming into vogue, in which the audio is "packaged" (often in encrypted form) with ancillary data.

Electronic distribution of music to the consumer is also gaining popularity, presently in the MP3 format primarily. The music providers may deal directly with the public, but more commonly effect such consumer distribution through a newly emerging tier of digital media outlets, such as internet sites that specialize in music. From such sites, consumers can download digital audio files into personal digital audio players. (The Diamond Rio, and the Audible MobilePlayer devices are some of the first of what will doubtless be a large number of entrants into this personal internet audio appliance market.) Or the downloaded data can be stored by the consumer-recipient onto any other writeable media (e.g. hard disk, CD, DVD, tape, videotape, etc.). Typically a personal computer is used for such downloading, but this intermediary may be dispensed with by coupling next generation of personal audio appliances to an internet-like link.

The data downloaded by the consumer can be stored either in the native digital format, translated into another digital format (which translation may include decryption), converted into analog and recorded in analog form, etc.

Unauthorized copying or use of the music can occur anywhere in the foregoing channels. However, one of the greatest risks occurs once the music has been delivered to the consumer (whether by tangible media, by traditional broadcast media outlets, by emerging digital distribution, or otherwise).

The general idea of embedding auxiliary data into music (i.e. watermarking) has been widely proposed, but so far has been of limited applicability.

For example, GoodNoise is planning to embed a digital signature -- termed a multimedia identifier, or MMI -- in its MP3 music. MMI will register the song and its author with a licensing number. In addition to providing information about the songwriter and distributor, this digital encoding may also include lyrics, liner notes, and other information. But all of the proposed uses serve only to convey information from the distributor to the consumer; use for "tracking" is actively disclaimed. (Wired News, "GoodNoise Tags MP3 Files," February 3, 1999.)

The Genuine Music Coalition – a partnership of various companies in the music distribution business – likewise has announced plans to employ watermarking of MP3 music. The watermarking technology, to be provided by Liquid Audio, will convey data specifying the artist or producer contact, copyright data, and a number to track ownership. The Coalition hopes that the provision of this embedded information will help thwart piracy. Industry observers believe Liquid Audio will next introduce playback technology only plays audio in which its watermark is detected. (Wired News, "Liquefying MP3," January 23, 1999.)

A similar initiative has been announced by the Recording Industry Association of America (RIAA). Termed the Secure Digital Music Initiative (SDMI), the program seeks to define a voluntary specification that will assure proper compensation to those who produce and distribute music. One element of the system will likely be a watermarking component. (Dow Jones Newswire, "Spurred By Maverick Technology, Music Industry Eyes Web," December 31, 1998.)

Yet another initiative has been announced by Solana and ASCAP. Other companies promoting watermarking for music include Aris Technology, MCY.com, and AudioSoft.

The watermark payload can represent various types of data. An exemplary payload includes data relating to the artist, distribution entity, title, and copyright date/proprietor. Additionally, the payload can include a digital object identifier – an ISBN-like number issued by a central organization (e.g. a rights management organization) to uniquely identify the work.

Such payload data can be encoded literally (e.g. the title by a series of ASCII characters, etc.). In other embodiments, codes or abbreviations can be employed – with each code having a known meaning. In still other embodiments, the data can be meaningless by itself, but may serve as a key (e.g., a Unique Identifier, or UID) into a remote data database or repository. An example of such a remote data repository is a web site at a Master Global Address (MGA) associated with content, as detailed below.

An exemplary data payload may, for example, have the following format:

A	B	C	D	E	F	G	H	I		

Where A is a six-byte (8-bits to a byte) ASCII string serving as a digital object identifier (which may serve as a link to a Master Global Address through a default name server, as discussed

below), B is a two-byte ASCII field serving as a key into an "artist" field of the remote database, C is a three-byte ASCII field serving as a key into a "title" field of the remote database; D is a 14-bit field serving as a key into a "label" field of the remote database, E is an 8-bit integer representing the work's year of first publication (with 0 representing the year 2000); F is a 10-bit field serving as a key into a "price" field of the remote database, G is a two-byte usage control string (detailed below), H is a streaming data channel, and I is a string of bits serving as a cyclic redundancy checksum for the foregoing. (More sophisticated error correcting checksums can, of course, be employed.) This payload format totals 136 bits, exclusive of the CRC coding and the streaming data channel.

This payload is encoded repeatedly, or redundantly through the music, so that the full payload can be decoded from partial excerpts of the music.

The encoding is also desirably perceptually adaptive, so that higher energy encoding is employed where the listener is less likely to perceive the additional "noise" introduced by the encoding, and vice versa. Various techniques for perceptually adaptive encoding are known. For example, some tie the amplitude of the encoded signal to the instantaneous amplitude of the music. Others exploit psychoacoustic "masking" of one signal by a spectrally-or temporally-adjoining signal of higher energy. Still other approaches fill gaps in the music's spectrum with watermark energy. These and other techniques are detailed in the patents incorporated by reference.

In other embodiments, perceptually adaptive encoding is not used. In some such embodiments, no tailoring of the temporal or spectral characteristics of the watermark signal is employed. In others, the watermark signal is spectrally filtered to emphasize low frequency audio components (e.g. less than 500 hz), high frequency audio components (e.g. higher than 2500 hz), or mid-frequency audio components (500-2500 hz).

The streaming data field channel (H) is a medium by which data can be conveyed from a distribution site (or other site) to the end user. Such data may be entirely unrelated to the underlying work. For example, it may serve a utilitarian purpose, such as conveying data to a memory in the consumer device to replace previously-stored data that is out-of-date. It may be a commercial channel on which bandwidth is sold for access to the consumer or the consumer's device. Essentially any purpose can be served by this streaming data field. Unlike most of the

other fields, the streaming data field may not endlessly repeat the same data, but can convey data that changes with time.

Desirably, the encoding is performed in a manner permitting recovery of the watermark data even if the audio is corrupted, e.g. by format conversion, re-sampling, tape wow and flutter, compression, coding, or various forms of audio processing (e.g. filtering, pre-emphasis, re-scaling, etc.). One way to provide for such robustness is to encode a signal of known character that can be recognized through all such corruption. By identifying such known signal, the watermark signal can then be decoded. (The known signal can take various forms, e.g. a synchronization signal, a marker signal, calibration signal, a universal code signal as described in applicant's patents, etc.)

In some embodiments, a watermark "dial-tone" signal is provided. This dial-tone signal is a low amplitude, relatively wideband, repetitive signal that commonly conveys only limited information (e.g. a single bit of information). Its presence in an audio signal can serve as a "do not record," or similar instruction signal. Alternatively, or in addition, the dial-tone signal can serve as an aid in "locking" to a plural-bit digital watermark signal that is also encoded in the audio. For example, the cyclical repetition of the signal can serve to identify the start of the plural-bit digital watermark signal. Or the spectrum or repetition rate of the signal can identify any temporal corruption of the audio. An exemplary such signal is detailed as a "simple universal code" in Patent 5,636,292.

A track of music can be pre-authorized for specified types of use. For example, the usage control string of the watermark payload may include a six-bit field detailing the classes of devices for which the audio is authorized. Each bit would correspond to a different class of device. Class 1 devices may be personal playback devices with only analog-audio output. Class 2 devices may be personal entertainment devices capable of outputting music in digital (e.g. MP3, redbook, *.WAV) format, as well as analog audio. Class 3 devices may be personal computer systems (i.e. with essentially unlimited ability for processing and outputting digital audio). Etc., etc. A device to which such MP3 audio is provided would check the usage control string data to determine whether it is authorized to utilize the audio. A personal playback device with analog-only output, for example, would examine the first bit of the usage control string. If it was "1," the device would be authorized to use (i.e. playback) the MP3 data; if it was a "0," the device would refuse to play the music.

In addition to pre-authorization for certain classes of devices, the usage control string can also include bits indicating the number of permitted playbacks. This data can be encoded in bits seven through nine, representing eight possibilities:

0 – no playback permitted

1 – single playback permitted

2 – two playbacks permitted

3 – three playbacks permitted

4 – four playbacks permitted

5 – five playbacks permitted

6 – 10 playbacks permitted

7 – unlimited playbacks permitted

8 – refer to associated data (within the watermark, or stored at a remote site) which specifies number of permitted playbacks.

The playback device may include a non-volatile store in which the number of permitted playbacks is stored for each track of music. The device would decrement this number at the beginning of each playback.

The usage control string can also include a two-bit field (bits ten and eleven) indicating recording permissions. A value of 0 means that data corresponding to the MP3 audio (regardless of digital format) should never be made available to another digital device. A value of 1 means that the data corresponding to the MP3 data may be made available once to another digital device. A value of 2 means that the data may be made available an unlimited number of times to other digital devices. (Value 3 is reserved.)

Another data field that can be included in an audio watermark is a rating that indicates age-appropriateness. Music with violence or sexual themes might be given a rating akin to the MPAA "PG-13" or "R" rating. Audio appliances may be programmed to recognize the rating of incoming music, and to interrupt playback if the rating exceeds a certain threshold setting. Various known techniques can be employed to assure that such settings cannot readily be changed, e.g., by juvenile listeners.

Another data field that can be included in an audio watermark is a date field. This field can indicate either the date the music was watermarked, or a date in the future on which certain rights associated with the music should change. Some consumers, for example may not wish to

purchase perpetual playback rights to certain musical selections. The right to play a selection for 6 months may suffice for many consumers, especially if the price is discounted in view of the limited term. Such an arrangement would not be wholly disadvantageous to music distributors, since some consumers may end up purchasing music twice if their initial assessment of a musical selection's appeal was too short-sighted. (Naturally, the playback equipment would require a source of real-time clock data against which the date field in the watermark can be checked to ensure that the playback rights have not yet expired.)

Another of the data fields that can be included in an audio watermark specifies technical playback parameters. For example, the parameter can cause the playback appliance to apply a spectral equalization that favors bass frequencies, or treble frequencies, or mid-range frequencies, etc. Other pre-configured equalization arrangements can similarly be invoked responsive to watermark data. Likewise, the parameter can invoke special-effects provided by the playback appliance, e.g., echo effects, reverb, etc. (Again, such parameters are usually represented in an abbreviated, coded form, and are interpreted in accordance with instructions stored in a memory (either in the playback appliance, or linked thereto).

The same data fields and principles can be applied to non-audio content. In video, for example, watermarked data can adaptively control the display monitor or playback parameters (e.g., color space) to enhance the viewing experience.

Music Asset Management/Commerce

The majority of domestic music piracy is not organized. Rather, it is a crime of opportunity and convenience. If the crime were made more difficult, the alternative of obtaining a copy through legitimate channels would be less onerous. Similarly, if the procedure for obtaining a copy through legitimate channels were simplified, the incentive for piracy would be reduced. Watermarking facilitates both – making the crime more difficult, and making legitimate music acquisition easier.

Consider, for example, the pricing of music in conventional record stores. A CD (compact disk) may cost $15, but its sale may be driven by just one or two popular songs on the disk. To obtain these songs, the consumers must purchase the entire disk, with perhaps a dozen songs of no particular interest. This, in essence, is a tying arrangement that benefits the record

labels while prejudicing the consumers. Given these circumstances, and a ready opportunity to make copies, it is not surprising that customers sometimes make illicit copies.

One classic technique of avoiding purchase of a complete collection of music, when only one or two songs is desired, is to record the music off the radio. While of dubious legality, this technique was popular in the era of combined cassette/radio players. However, the desired music was sometimes difficult to encounter in a radio broadcast, and the quality was less than superb.

The combined cassette/radio player has now evolved into a general purpose computer with wide-ranging functionality, and other sophisticated devices. Music can be acquired off the web, and can be recorded in various forms (e.g. in a personal MP3 player, stored on a hard disk, stored on a writeable CD-ROM, played back and recorded on analog cassette, etc., etc.). The quality can be quite high, and the erratic broadcast time problems of radio broadcasts have been overcome by the web's on-demand delivery mechanisms. (Moreover, the music can be downloaded in faster-than-realtime, a further benefit over recording-off-the-air techniques.)

One hybrid between the new and old is a novel radio (e.g., for use in a car) that has a "capture" button on the front panel (or other form of user interface, e.g., a Capture icon on a GUI). If a user hears a song they want to record and keep, they press the Capture button while the song is playing. In response, the radio device decodes a watermark embedded in the music, and thereby knows the identity of the music. The radio then makes a wireless transmission identifying the user and the desired song. A local repeater network picks up the wireless signal and relays it (e.g. by wireless rebroadcast, by modem, or other communication medium) to a music clearinghouse. The clearinghouse charges the user a nominal fee (e.g. via a pre-arranged credit card), and queues the music for download to a predetermined location associated with the user.

In one embodiment, the predetermined location is the user's own computer. If a "live" IP address is known for the user's computer, the music can be transferred immediately. If the user's computer is only occasionally connected to the internet, the music can be stored at a web site (e.g. protected with a user-set password), and can be downloaded to the user's computer whenever it is convenient.

In other embodiments, the predetermined location is a personal music library maintained by the user. The library can take the form, e.g., of a hard-disk or semiconductor memory array in which the user customarily stores music. This storage device is adapted to provide music data to

one or more playback units employed by the user (e.g. a personal MP3 player, a home stereo system, a car stereo system, etc.). In most installations, the library is physically located at the user's residence, but could be remotely sited, e.g. consolidated with the music libraries of many other users at a central location.

The personal music library can have its own internet connection. Or it can be equipped with wireless capabilities, permitting it to receive digital music from wireless broadcasts (e.g. from the clearinghouse). In either case, the library can provide music to the user's playback devices by short-range wireless broadcast.

By such arrangement, a user can conveniently compile an archive of favorite music – even while away from home.

Many variants of the foregoing are of course possible. The radio can be a portable unit (e.g. a boombox, a Walkman radio, etc.), rather than an automotive unit. The UI feature employed by the user to initiate capture a musical selection need not be a button (physical or on-screen). For example, in some embodiments it can be a voice-recognition system that responds to spoken commands, such as "capture" or "record." Or it can be a form of gesture interface.

Instead of decoding the watermark only in response to the user's "capture" command, the radio can decode watermarks from all received programs, and keep the most recent in a small FIFO memory. By such arrangement, the user need not issue the capture instruction while the song is playing, but can do so even after the song is finished.

In some embodiments, data corresponding to the watermark can be made available to the user in various forms. For example, it can be presented to the user on an LCD screen, identifying the artist and song currently playing. If a corresponding UI button is activated, the device can so-identify the last several selections. Moreover, the data need not be presented to the user in displayed form; it can be annunciated by known computer-speech technologies instead.

In embodiments in which the watermark does not convey ASCII text data, but instead conveys UIDs, or coded abbreviations, the device must generally interpret this data before presenting it to the user. In an illustrative embodiment, the device is a pocket-sized FM radio and is equipped with a 1 megabyte semiconductor non-volative RAM memory. The memory includes a data structure that serves as a look-up table, matching code numbers to artist names and song titles. When the user queries the device to learn the identify of a song, the memory is

indexed in accordance with one or more fields from the decoded watermark, and the resulting textual data from the memory (e.g. song title and artist) is annunciated or displayed to the user.

In most applications, such memory will require frequent updating. The RF receiver provides a ready mechanism for providing such updated data. In one embodiment, the radio "awakens" briefly at otherwise idle moments and tunes to a predetermined frequency at which updated data for the memory is broadcast, either in a baseband broadcast channel, or in an ancillary (e.g. SCA) channel.

In variants of the foregoing, internet delivery of updated memory data can be substituted for wireless delivery. For example, the artist/song title memory in the personal player can be updated by placing the player in a "nest" every evening. The nest (which may be integrated with a battery charger for the appliance) can have an internet connection, and can exchange data with the personal device by infrared, inductive, or other proximity-coupling technologies, or through metal contacts. Each evening, the nest can receive an updated collection of artists/song titles, and can re-write the memory in the personal device accordingly. By such arrangement, the watermark data can always be properly intepreted for presentation to the user.

The "Capture" concepts noted above can be extended to other functions as well. One is akin to forwarding of email. If a consumer hears a song that another friend would enjoy, the listener can send a copy of the song to the friend. This instruction can be issued by pressing a "Send" button, or by invoking a similar function on a graphical (or voice- or gesture-responsive) user interface. In response, the appliance so-instructed can query the person as to the recipient. The person can designate the desired recipient(s) by typing in a name, or a portion thereof sufficient to uniquely identify the recipient. Or more typically, the person can speak the recipient's name. As is conventional with hands-free vehicle cell phones, a voice recognition unit can listen to the spoken instructions and identify the desired recipient. An "address book"-like feature has the requisite information for the recipient (e.g., the web site, IP address, or other data identifying the location to which music for that recipient should stored or queued, the format in which the music should be delivered, etc.) stored therein. In response to such command, the appliance dispatches instructions to the clearinghouse, including an authorization to debit the sender's credit card for the music charge. Again, the clearinghouse attends to delivery of the music in a desired manner to the specified recipient.

Still further, a listener may query the appliance (by voice, GUI or physical button, textual, gesture, or other input) to identify CDs on which the then-playing selection is recorded. Or the listener may query the appliance for the then-playing artist's concert schedule. Again, the appliance can contact a remote database, relay the query, and forward data from the watermark payload identifying the artist and/or song title to which the query relates. The database locates the requested data, and relays same back to the appliance for presentation (via a display, by machine speech, or other output) to the user. If desired, the user can continue the dialog with a further instruction, e.g., to buy one of the CDs on which the then-playing song is included. Again, this instruction may be entered by voice, GUI, etc., and dispatched from the applicance to the clearinghouse, which can then complete the transaction in accordance with pre-stored information (e.g. credit card account number, mailing address, etc.). A confirming message is relayed to the appliance for presentation to the user.

While the foregoing transactions require a link to a remote site or database, other watermark-based consumer services can be provided without such a link. For example, a user can query the appliance as to the artist or song-title of the selection currently playing. The appliance can consult the embedded watermark data (and optionally consult a memory to determine the textual names associated with coded watermark data), and provide the requested information to the user (e.g., by a display, annunciation, or other output).

The foregoing concepts (e.g. Capture, Send, etc.) can also be employed in connection with internet- rather than radio-delivery of music. (The following discussion is illustrated with reference to the "Capture" function, but it will be recognized that the other earlier-discussed features can be similarly implemented.)

There are many commercial web sites that sell audio (in CD form or otherwise), and offer limited free music downloads, (or music clips) as an enticement to lure consumers. But there are also a great number of music web sites that have no commercial pretense. They are hosted by music lovers strictly for the enjoyment of other music lovers. When music is downloaded from such a web site, the end-user's computer can analyze the digital data to decode watermark data therefrom. Again, the user can be presented with a "Capture" button that initiates a commercial transaction, by which a complete copy of the then-downloaded audio is sent to a prearranged storage location, and the user's credit card is debited accordingly. This transaction can occur

independently of the site from which the music is downloaded (e.g. through the clearinghouse referenced above).

While the "Capture" button can be presented on the web-site, this would generally not be in keeping with the non-commercial nature of such web sites. Instead, in an exemplary embodiment, the Capture feature is a software program resident at the user's computer. When this software program is invoked by the user, a socket channel is instantiated between the user's computer and the clearinghouse over the then-existing internet connection. The decoded watermark data and user ID is transmitted to the clearinghouse over this channel, without interrupting the user's other activity (e.g. downloading music from the non-commercial web site). In response, the clearinghouse transmits the music to the prearranged location and attends to billing.

In some embodiments, a watermark detector is included as part of the operating system, and constantly monitors all TCP/IP, or other internet, data received by the user's computer, for the presence of watermarks. In such case, when the Capture feature is invoked, the program examines a memory location in which the operating system stores the most-recently received watermark data. In another embodiment, the computer does not monitor all internet traffic for embedded watermark data, but includes an API that can be called by the Capture program to decode a watermark from the data then being received. The API returns the decoded watermark data to the Capture program, which relays same to the clearinghouse, as above. In still another embodiment, the watermark decoder forms part of the Capture program, which both decodes the watermark and relays it to the clearinghouse when the Capture program is invoked by the user.

There are various techniques by which the Capture program can be selectively invoked. One is by a keyboard macro (e.g. by a combination of keyboard keys). Another is by a program icon that is always presented on the screen, and can be double-clicked to activate. (Again, confirmation processes may be called for, depending on the likelihood of inadvertent invocation.) Many other techniques are likewise possible.

In the just-contemplated scenario, the Capture operation is invoked while the user is downloading music from a non-commercial web site. This seems somewhat redundant, since the downloading – itself -- is transferring music to the user's computer. However, the Capture operation provides added value.

In the case of streaming audio, the audio is not typically stored in a location in which it can be re-used by the consumer. It can be listened-to as delivered, but is then gone. Capturing the audio provides the user a copy that can be played repeatedly.

In the case of downloaded music files, the music may have been encoded to prevent its recordal on other devices. Thus, while the user may download the music onto a desktop computer, copy-prevention mechanisms may prevent use of that file anywhere else, e.g. on a portable music appliance. Again, Capturing the audio provides the user a copy that can be transferred to another device. (The music file provided by the clearinghouse can have copy-prevention limits of its own – e.g., the file can be copied, but only once, or the file can be copied only onto devices owned by the user.)

(Confirmation of device ownership can be implemented in various ways. One is to identify to the clearinghouse all music devices owned by a user at the time the user registers with the clearinghouse (supplemented as necessary by later equipment acquisitions). Device IDs associated with a user can be stored in a database at the clearinghouse, and these can be encoded into the downloaded music as permitted devices to which the file can be copied, or on which it can be played.)

The commerce opportunity presented by non-commercial music web-sites is but one enabled by digital watermarks. There are many others.

To take one example, consider the media by which music and artists are presently promoted. In addition to radio airtime, these include music videos (a la MTV), fan magazines, web advertisements, graphical icons (e.g. the Grateful Dead dancing bears), posters, live events, movies, etc. Watermarked data can be used in all such media as a link in a commercial transaction.

A poster, for example, typically includes a photo of the artist, and may comprise cover-art from a CD. The photo/art can be digitally watermarked with various types of data, e.g., the artist's identify, the record label that distributes the artist's work, the music project being particularly promoted by the poster (e.g. a CD, or a concert tour), a fan web-site related to the artist, a web-site hosted by the record label for selling audio in CD or electronic form, a web-site from which free music by the artist can be downloaded, data identifying the poster itself, etc.

A user, equipped with a portable appliance that merges the functions of palmtop computer and digital camera, can snap an image of the poster. The processor can decode the watermarked data, and initiate any of various links based on the decoded data.

In an exemplary embodiment, after snapping the picture, the user invokes a software program on the device that exposes the various links gleaned from the snapped image data. Such a program can, for example, present the option of linking to the artist's fan web site, or downloading free streaming audio or music clips, or ordering the promoted CD, or requesting the above-noted clearinghouse to download a personal copy of selected song(s) by the artist to the user's personal music library, etc. (The device is presumed to have a wireless internet link. In devices not having this capability, the requested actions can be queued and automatically executed when a link to the internet is available.)

Still more complex transactions can be realized with the use of a remote database indexed by digital watermark fields decoded from the poster. For example, the poster may promote a concert tour. Fields of the digital watermark may identify the artist (by a code or full text), and a web site or IP address. The user appliance establishes a link to the specified site, and provides the artist identifier. In response, the site downloads the tour schedule for that artist, for display on the device. Additionally, the downloaded/displayed information can include a telephone number that can be used to order tickets or, more directly, can indicate the class of seats still available at each (or a selected) venue, and solicit a ticket order from the user over the device. The user can supply requested information (e.g. mailing address and charge card number) over the return channel link (wireless or wired, as the case may be), and the ticket(s) will be dispatched to the user. In the case of a wireless link, all of this can occur while the user is standing in front of the movie poster.

Similar systems can be implemented based on watermark data encoded in any other promotional media. Consider music videos. Using known TV/computer appliances, watermark data added to such videos can readily be decoded, and used to establish links to audio download, CD-sales, fan club, concert ticket outlet web sites, etc., as above.

Even live events offer such watermark-based opportunities. The analog audio fed to public address or concert speakers can be watermarked (typically before amplification) to encode plural-bit digital data therein. A next generation personal music appliance (e.g. one with a wireless interface to the internet) can include analog record capability (e.g. a built-in

microphone, analog-to-digital converter, MP3 encoder, coupled to the unit's semiconductor memory). A user who attends a live event may record an excerpt of the music. The watermark can then be decoded, and the extracted data used to access the links and commerce opportunities reviewed above.

Cinema movies offer both audio and visual opportunities for watermark-based commerce opportunities. Either medium can be encoded to convey information of the types reviewed above. A personal appliance with image- or audio-capture capabilities can capture an excerpt of the audio or imagery, decode the watermark data therefrom, and perform any of the linking, etc., functions reviewed above.

The consumer-interest watermarks reviewed above are only exemplary. Many others will be recognized as useful. For example, promotional clips presented before a feature film presentation can include watermark data that point (either by a literally encoded web address link, or by an ID code that indexes a literal link in a remote link database) to reviewer critiques of the previewed movies. Watermark data in a featured film presentation can lead to web sites with information about the movie stars, the director, the producer, and can list other movies by each of these persons. Other watermark-conveyed web links can present opportunities to buy the movie on videotape, to purchase the movie soundtrack, to buy movie-related toys and games, etc.

More on Device Control

Much of the foregoing has focused on watermark encoding to provide enhanced customer experiences or opportunities. Naturally, watermarks data can alternatively, or additionally, serve the interests of the media owner.

To illustrate, consider watermarked music. The media owner would be best served if the watermark serves dual purposes: permissive and restrictive. Permissively, music appliances can be designed to play (or record) only music that includes an embedded watermark signaling that such activity is authorized. By this arrangement, if music is obtained from an unauthorized source and does not include the necessary watermark, the appliance will recognize that it does not have permission to use the music, so will refuse requests to play (or record).

As noted, music appliances can respond restrictively to the embedded watermark data to set limits on use of the music. Fields in the watermark can specify any or all of (or others in addition to) (a) the types of devices on which the music can be played (b) the types of devices on

which the music can be recorded; (c) the number of times the music can be played; (d) the number of times the music can be recorded, etc.

The device restrictions (a) and (b) can be of various types. In some embodiments, the restrictions can identify particular units (e.g. by serial number, registered owner, etc.) that are authorized to play/record the encoded music. Or the restrictions can identify particular classes of units (e.g., battery-powered portable players with music memories of less than 50 megabytes, disk-based dedicated music appliances, general purpose personal computers, etc.) Or the restrictions can identify particular performance quality criteria (e.g., two channel, 16-bit audio at 44.1KHz sample rate, or lower quality).

The use restrictions (c) and (d) can likewise be of various types. Examples include "do not copy," "copy once only," "unrestricted copying permitted," "play once," "play N times" (where N is a parameter specified elsewhere in the watermarked data, or by reference to a database indexed by a watermark data field), "unrestricted playing permitted," etc.

It is straightforward to design a music appliance to respond to usage limits of zero (e.g. "do not copy") and infinity (e.g. "unrestricted copying permitted," and "unrestricted playing permitted"). The device simply examines one or more bits in the watermark data, and permits (or refuses) an operation based on the value thereof.

Implementation of the other usage-control restrictions can proceed in various ways. Generally speaking, the stored music can be altered to give effect to the usage-control restrictions. For example, if the music is "record-once," then at the time of recording, the appliance can alter the music in a fashion indicating that it now has "do not record" status. This alteration can be done, e.g., by changing the watermark data embedded in the stored music (or adding watermark data), by changing other data stored in association with the music, etc. If the original signal is stored (as opposed, e.g., to a streaming signal, such as an internet or wireless transmssion), it too should be so-altered.

Likewise with playback limitations. The number of playbacks remaining can, e.g., be encoded in an updated watermark in the music, be tracked in a separate counter, etc.

More particularly considering the "copy once" usage restriction, an illustrative embodiment provides two distinct watermark payload bits: a "copy once" bit and a "copy never" bit. When originally distributed (whether by internet, wireless, or otherwise), the "copy once" bit is set, and the "copy never" bit is un-set.

When music encoded in this fashion is provided to a compliant recording device, the device is authorized to make one copy. (A compliant device is one that recognizes encoded watermark data, and behaves as dictated by the watermark.) When this privilege is exercised, the recording device must alter the data to ensure that no further copying is possible. In the illustrated embodiment, this alteration is effected by the recording device adding a second watermark to both the music, with the "copy never" bit asserted. The second watermark must generally be encoded in an "orthogonal" domain, so that it will be detectable notwithstanding the continued presence of the original watermark. Compliant equipment must then check for both watermarks, and refuse to copy if either is found to have the "copy never" bit asserted.

One advantage to this arrangement is that if the watermark signal has undergone some form of corruption (e.g. scaling or resampling), the first watermark may have been weakened. In contrast, the second watermark will be native to the corrupted signal, and thus be more easily detected. (The corruption may also contribute to the orthogonality of one watermark relative to the other, since the two watermarks may not have precisely the same time base or other foundation.)

An alternative approach is not to encode the "copy never" bit in the original music, but leave this bit (in whatever manifestation) blank (i.e. neither "1" nor "0"). In transform-based watermark techniques, this can mean leaving transform coefficient(s) corresponding to the "copy never" bit un-changed. If the watermarking is effected in the temporal sample domain (or spatial domain, for image data), this can mean leaving certain samples (pixels) unmodified. The recording device can then alter the transform coefficients and/or samples as necessary to assert the previously-unencoded "copy never" bit when the permitted recording is made.

In such a system, compliant recording devices check for the "copy never" bit in the sole watermark, and refuse to make a copy if it is asserted (ignoring the value of any "copy once" bit).

A third approach to "copy once" is to set both the "copy once" and "copy never" bits, but set the former bit very weakly (e.g. using lower gain and/or high frequency DCT coefficients that do not survive certain processing). The frail "copy once" bit is designed not to survive common corruptions, e.g., resampling scaling, digital to analog conversion, etc. To further assure that the "copy once" bit is lost, the recording device can deliberately add a weak noise signal that masks

this bit (e.g. by adding a noise signal in the frequency band whose DCT coefficient conveys the "copy once" bit). In contrast, the "never copy" bit is unchanged and reliably detectable.

In such a system, compliant devices check for the "copy once" bit in the sole watermark, and refuse to make a copy if it is not detected as set.

These three examples are but illustrations of many possible techniques for changing the rights associated with a work. Many other techniques are known. See, e.g., the proposals for watermark-based copy control systems for digital video at the Copy Protection Technical Working Group, http://www.dvcc.com/dhsg/, from which certain of the foregoing examples are drawn. See also Bloom et al, "Copy Protection for DVD Video," IEEE Proceedings, Special Issue on Identification and Protection of Multimedia Information, June, 1999.

Scaleability

One feature that is desirable in many detector embodiments is scaleability. This refers to the ability of a detector to scale its computational demands to match the computational resources available to it. If a detector is running on a high performance Pentium III workstation, it should be "doing more" than if the same detector is running on a slow microcontroller. One way scalability can be achieved is by processing more or less chunks of input data (e.g. temporal excerpts of music, or blocks/macroblocks of pixels in a frame of video data) to decode watermarks. For example, an input audio stream might be broken into chunks of one second each. A fast processor may complete decoding of each chunk in less than a second, permitting it successively to process each chunk in the data stream. In contrast, a slow processor may require two and a half seconds to decode the watermark from a chunk. While it is processing a first chunk, the second and third pass by un-decoded. The processor next grabs and processes the fourth chunk, permitting the fifth and sixth to pass by un-encoded.

The detector running on the fast processor is clearly more difficult to "fool," and yields a decoded watermark of higher confidence. But both systems decode the watermark, and both operate in "real time."

The skipping of input data in the temporal (e.g. music or video) or spatial (e.g. image or video) domain is but one example of how scaleability can be achieved. Many other approaches are known to those skilled in the art. Some of these alternatives rely on spending more or less time in the data analysis phases of watermark decoding, such as cross-correlation operations.

Reference has been made to watermarked UIDs as referring to a database from which larger data strings (e.g. web addresses, musician names, etc.) can be retrieved. In some embodiments, the data record referenced by a UID can, in turn, point to several other database records. By such arrangements, it is often possible to reduce the payload of the watermark, since a single UID reference can lead to several different data records.

Production Tools

In the prior art, the watermark embedded in a source material is typically consistent and static through a work – unchanging from beginning to end. But as will be recognized from the foregoing, there are many applications that are better served by changing the watermark data dynamically during the course of the work. According to another aspect of the invention, a production tool is provided that facilitates the selection and embedding of dynamically-changing watermark data. One such embodiment is a software program having a user interface that graphically displays the different watermark fields that are being embedded in a work, and presents a library of data (textually or by icons) that can be inserted into each field, and/or permits the user to type in data to be encoded. Another control on the UI controls the advance and rewind of the media, permitting the user to determine the location at which different watermark data begins and ends. Graphical paradigms known from video- and audio-editing tools can be used to indicate the starting and ending frames/samples for each different watermark payload.

Such a tool can be of the standalone variety, or can be integrated into the desktop audio- and video- production and editing tools offered by vendors such as Avid, Adobe, Jaleo, Pinnacle Systems, SoundForge, Sonic Foundry, Xing Technology, Prosoniq, and Sonic Desktop Software.

Payment-Based Systems

Another aspect of the present invention is the use of anonymous payment tokens that can be used to obtain content on the web. In one embodiment, a token comprises a 128-bit pseudo-random number, to which additional bits identifying an issuing bank (or other issuing institution) are appended. (The additional bits can be the IP address of a web server of the bank, a routing number identifying the bank for electronic wire transfers, or other identifier.) The 128-bit

numbers are randomly generated by the bank – commonly as needed – and each represents a fixed increment of money, e.g. ten cents.

A consumer wishing to have a store of currency for such commerce pays the bank, e.g., $10 in exchange for 100 tokens. These tokens are transferred electronically to disk or other storage in the consumer's computer in response, e.g., to a credit card authorization, or may be provided by diskette or other storage medium over the counter at a bank branch (in which case the consumer thereafter copies the numbers into storage of his or her computer). (Outlets other than banks can of course be employed for distributing such numbers, much in the manner that convenience and many grocery stores commonly issue money orders.)

Imagine that the consumer wishes to view the final quarter of a Trailblazer basketball game that aired on television a week ago. (The consumer may have either missed the game, or may have seen it but wants to see the last quarter again.) The user directs a web browser to a web site maintained for such purpose and performs a search to identify the desired program. (Typically, the web site is maintained by the proprietor that holds the copyright in the material, but this need not be the case. Some material may be available at several web sites, *e.g.,* maintained by ABC Sports, the National Basketball Association, and Sports Illustrated.) The search can use any of various known search engines, e.g., Infoseek, Verity, etc., and can permit searching by title terms, keywords, date of airing, copyright owner, etc. By typing in, e.g., the keyword 'Trailblazers' and the date '4/26/99,' the consumer is presented a listing of videos available for download. One, hopefully, is the requested game. With each listing is an indication of an associated nominal charge (e.g. 80 cents).

On clicking on a hypertext link associated with the desired basketball game, the viewer is presented a further screen with one or more options. The first of the listed options is the entire game, with commercials. The charge is the nominal charge presented on the earlier screen (i.e. 80 cents). Other options may include the first, second, third, and fourth quarters of the game individually, each of which – save the last, costs 20 cents. The last may be charged at a premium rate, e.g., 30 cents. Clicking on the desired video option yields a further screen through which payment is effected.

To pay for the requested video, the consumer instructs his or her computer to transfer three of the earlier-purchased tokens over the web to the video provider. Various user interface metaphors can be employed to facilitate this transfer, e.g., permitting the user to type the amount

of money to be transferred in a dialog box presented on-screen, or dropping/dragging icons representing tokens from an on-screen "wallet" to an on-screen "ticket booth" (or over an icon or thumbnail representing the desired content), clicking on an "increment" counter displayed adjacent the listing of the content, etc. Once the consumer has authorized a transfer of sufficient tokens, the consumer's computer sends to the web site (or to such other web address as HTML encoding in the viewed web page may indicate) the tokens. This transmission simply takes the form of the three 128+ bit numbers (the '+' indicating the bank identifier) – in whatever packet or other format may be used by the internet link. Once dispatched in this manner, the tokens are deleted from the user's computer, or simply marked as spent. (Of course, in other embodiments, a record of the expenditure may be stored in the consumer's computer, e.g., with the token contents and a record of the audio or video purchase to which they were applied.)

Since the amount of money is nominal, no encryption is provided in this embodiment, although encryption can naturally be provided in other embodiments (e.g., either in sending the tokens from the user to the web site, or earlier, in sending the tokens to the user). As will be seen, provided that the media provider immediately sends the tokens to the bank in real time, encryption is a nice feature but not mandatory

On receipt of the token data, the web site immediately routes the token data to the identified bank, together with an identifier of the media provider or account to which the funds represented thereby are to be credited. The bank checks whether the 128-bit numbers have been issued by that bank, and whether they have already been spent. If the numbers are valid, the bank updates its disk-based records to indicate that the three tokens have been spent and that the bank now owes the media supplier 30 cents, which it may either pay immediately (e.g., by crediting to an account identified by the media provider) or as one lump sum at the end of the month. The bank then sends a message to the web site confirming that the tokens were valid and credited to the requested account. (Optionally, a message can be sent to the purchaser of the tokens (if known), reporting that the tokens have been redeemed.)

In response, the web site begins delivery of the requested video to the consumer. In the illustrated embodiment, the video is watermarked prior to delivery, but otherwise sent in unencrypted fashion, typically in streaming format, but optionally in file format. (Encryption can be used in other embodiments.) The watermarking in the illustrated embodiment is accomplished

on-the-fly and can include various data, including the date of downloading, the download site, the destination IP address, the identity of the purchaser (if known), etc.

The large size of the video and the small charge assessed therefor provide disincentives for the consumer making illicit copies. (Especially as to archival material whose value decays with time, there is not much after-market demand that could be served by illicit copies, making third party compilation of such material for re-distribution financially unattractive. First run video, and material that keeps a high value over time, would not be as well suited for such distribution, and could better employ technology disclosed elsewhere herein.)

In some embodiments, the integrity of the received video is checked on receipt. This feature is described below in the section entitled Watermark-Based Receipts.

In the illustrative system, nothing in the tokens indicates the identity of the purchaser. The web site knows the IP address of the site to which video was delivered, but need not otherwise know the identity of the purchaser. The bank would probably maintain a record of who purchased the tokens, but need not. In any event, such tokens could thereafter be exchanged among consumers, resulting in anonymity from the bank, if desired.

As described above, the video excerpts from which the consumer can select include commercials. At some sites, video may be provided from which the commercials have been excised, or which is delivered in a manner that skips past the commercials without transmitting same to the consumer. Such video will naturally command a premium price. In some embodiments, the difference in price is electronically credited as compensation to accounts maintained for (or by) the advertisers, whose advertisements are not being viewed by such consumers. (The identification of advertisers to be credited is desirably permanently encoded in the video, either throughout the video (if the video has had the commercials removed therefrom), or by data in the commercials themselves (which commercials are skipped for transmission to the consumer, but can still be decoded at the video head-end. Such encoding can be by in-band watermarking or otherwise.)

While the foregoing discussion particularly considered video as the desired content, the same principles are equally applicable in connection with audio, still imagery, and other content.

The token-based payment method is but one of many that can be employed; the literature relating to on-line payment mechanisms is extensive, and all such systems can generally be here-employed.

Tracking 128-bit tokens can be a logistical problem for the bank. One approach is to have a memory with 10^{128} locations, and at each location store a two-bit value (e.g. 00=never issued; 01=issued but not spent; 10=issued and spent; 11=reserved). More complete data could alternatively be stored, but such a memory would be impractically large.

One alternative approach is to hash each 128-bit number, when issued, to a much smaller key value (e.g. 20 bits). A memory with 10^{20} locations can be indexed by this key. Each such location can include four data: an issued 128-bit token number that hashes to that value, first and second date fields indicating the date/time on which that token was issued and redeemed, respectively, and a link specifying the address of a next memory location. That next memory location (outside of the original 10^{20} locations) can include four more data, this time for a second issued-128-bit token number that hashed to the original key value, two date fields, and again with a link to a subsequent storage location, etc.

When a 128-bit random number is generated, the original memory location indexed by the hash code of that number is checked for an earlier number of the identical value (to avoid issuance of duplicate tokens). Each successive location in the linked chain of memory locations is checked for the same 128-bit number. When the end of the linked chain is reached, the bank knows that the 128-bit random number has not previously been issued, and writes that number in the last-addressed location, together with the date of issuance, and a link to a next storage location.

When a 128-bit token is received, the same linked-list processing occurs to identify a first location, and to thereafter step through each subsequent location until a match is found between the token number and the number stored in one of the linked memory locations. When found, that number is marked as redeemed by writing a redemption date/time in the corresponding field. If the search reaches the end of the linked chain without finding a match between the stored numbers and the token number, the token is treated as invalid (i.e. not issued by that bank).

Other manners of tracking the large number of possible token numbers can of course be used; the foregoing is just exemplary. Or the tokens needn't be tracked at all. Such an arrangement is highly practical if the token has sufficient bits. With the illustrated 128 bits, for example, the chance of two identical tokens being issued is infinitesimally small, so checking for duplicate issuance can be omitted if desired. In such case, the bank can simply maintain an ordered list of the token numbers still outstanding and valid. As new tokens are dispensed, their

token numbers are added to the list. As tokens are redeemed, their numbers are deleted from the list. Known list processing techniques can be employed to speed such search, update, and delete actions.

Watermark-Based Receipts

Pay-for-content applications commonly assume that if content is transmitted from a server (or head-end, etc.), it is necessarily received. Sometimes this assumption is wrong. Network outages and interruptions and internet traffic load can diminish (e.g., dropped video frames), or even negate (e.g., failed delivery), expected consumer enjoyment of content. In such cases, the consumer is left to haggle with the content provider in order to obtain an adjustment, or refund, of assessed charges.

Watermarks provide a mechanism for confirming receipt of content. If a watermark is detected continuously during a download or other delivery event, a software program (or hardware device) can issue an electronic receipt attesting that the content was properly delivered. This receipt can be stored, and/or sent to the content distributor to confirm delivery.

In one embodiment, a content receiving device (e.g., computer, television or set-top box, audio appliance, etc.) periodically decodes a watermark from the received content to confirm its continued reception. For example, every five seconds a watermark detector can decode the watermark and make a record of the decoded data (or simply record the fact of continued detection of the same watermark). When a changed watermark is detected (i.e., reception of a different content object begins), the duration of the previously-received content is logged, and a receipt is issued.

In a related embodiment, the last portion (e.g., 5 seconds, frame, etc.) of the content bears a different "end of content" watermark that triggers issuance of a receipt. Such a watermark can indicate the length of the content, to serve as a cross-check against the periodic watermark polling. (E.g., if periodic sampling at 2 second intervals yields 545 samples corresponding to the same content, and if the "end of content" watermark indicates that the content was 1090 seconds long, then receipt of the entire content can be confirmed.)

In another embodiment, the watermark can change during the course of the content by including, e.g., a datum that increments every frame or other increment of time (e.g., frame number, time stamp, etc.). A watermark detector can monitor the continued incrementing of this

datum throughout the content to confirm that no part was garbled (which would destroy the watermark) or was otherwise missing. Again, at the end of delivery, the receiving system can issue a confirmation that XXX frames/seconds/etc. of the identified content were received.

One application of such technology is to bill for content based on receipt, rather than transmission. Moreover, billings can be adjusted based on percentage of content-value received. If delivery is interrupted mid-way through (e.g., by the consumer disabling the content-receiving device), the nominal billing for the content can be halved. Some prolonged content, e.g., televised/web-broadcast university classes, cannot be "consumed" in one session, and are thus particularly well suited for such pay-as-you-consume billing.

Another application of such technology is in advertising verification. Presently, ads are tracked by transmission or, less frequently, by detection of an embedded code on receipt (*c.f.*, Nielsen Media Research's patents 5,850,249 and 5,737,025). However, such reception-detectors – once triggered – generally do not further note the length of time that the advertising was received, so the same data is produced regardless of whether only five or fifty seconds of a commercial is presented. Watermark monitoring as contemplated herein allows the duration of the advertising impression to be precisely tracked.

In one application of this technology, recipients of advertising are provided incentives for viewing advertising in its entirety. For example, a content-receiving device can include a watermark detector that issues a receipt for each advertisement that is heard/viewed in its entirety. These receipts can be redeemed, e.g., for content tokens as described elsewhere herein, for monetary value, etc. In some embodiments, receipts are generic and can all be applied to a desired premium, regardless of the advertisements through which they were earned. In other embodiments, the receipts are associated with the particular advertisers (or class of advertisers). Thus, a TV viewer who accumulates 50 receipts from advertising originating from Procter & Gamble may be able to redeem same for a coupon good for $2.50 off any Procter & Gamble product, or receipts from Delta Airlines may be redeemed for Delta frequency flier miles (e.g., at a rate of one mile per minute of advertising). Such incentives are particularly useful in new forms of media that give the consumer enhanced opportunities to fast-forward or otherwise skip advertising.

(Although the foregoing "receipt" concept has been described in conjunction with watermark data (and use of watermark technology is believed to be inherently advantageous in

this application), the same principles can likewise be implemented with ancillary data conveyed by other means.)

Master Global Address

As suggested above, it is desirable that each piece of content have a web address (the "Master Global Address" (MGA), or "Master IP Address") associated with it. Such address is typically conveyed with the content, e.g., by an IP address watermarked therein.

Consider a consumer who downloads a streaming video having an English language soundtrack. The viewer may not speak English, or may otherwise prefer to listen to the soundtrack in another language. The user can decode the watermark data embedded in the video and initiate a link to the associated web address. There the user is presented with a list of soundtracks for that content object in other languages. The viewer can click on the desired language and receive same via a second simultaneous transmission (e.g., a second socket channel). The consumer's audio/video appliance can substitute the desired audio track for the default English track.

If the streaming video and the alternative soundtrack are hosted on the same server, synchronization is straightforward. The process governing transmission of the alternative soundtrack identifies the process that is streaming video to the same IP address. Based on SMPTE, or other time/frame data, the former process syncs to the latter. (If the two data streams don't originate through the same server, time/frame data can be relayed as necessary to the alternative soundtrack server to effect synchronization.)

Another application of the Master Global Address is to serve as a point to which monitoring stations can report the presence, or passage, of content. Consider, for example, a copyright-aware node through which content signals pass, e.g., a computer node on a network, a satellite transponder, etc. Whenever the node detects passage of a media object (e.g., by reference to a file extension, such as MP3, JPG, AVI, etc.), it sends a "ping" over the internet to the address encoded in the object, simply reporting passage of the object. Similar monitoring facilities can be provided in end user computers, e.g., reporting FileOpen, FileSave, Printing, or other use of content bearing MGA data.

This system can be expanded to include "ping" and "pong" phases of operation. When a software application (or a user appliance, such as a video or audio playback device) encounters a

media object (e.g., at time of file open, at time of playback, etc.), it pings the MGA site to report the encounter. The MGA site "pongs" back, responding with instructions appropriate to the encounter. For example, if the object requires payment of a fee before full functionality or access is to be granted, the MGA site can respond to the application with instructions that the object be used (e.g., played back) only in some crippled state preventing the user's full enjoyment (e.g., impaired resolution, or impaired sound quality, or excerpts only, etc.). The MGA site can also inform the user application of the terms (e.g., payment) by which full functionality can be obtained. The application can graphically or audibly present such information to the user, who can authorize a payment, if desired, so that the content can be enjoyed in a less- (or un-) crippled state. On receipt of the payment authorization, the MGA site can inform the user application that enhanced access/usage rights have been purchased, and that the application may proceed accordingly.

Yet another application of the MGA is to present the user of a content object a menu of options that is customized to that object.

In current graphical operating systems, when a user clicks on an icon (e.g., with the right mouse button), a menu is presented detailing actions that can be undertaken in connection with the icon, or the file represented thereby. Such options are pre-programmed (i.e., static), and are typically determined by the operating system based solely on the file extension.

In accordance with this aspect of the present invention, clicking on an icon representing a media object initiates an internet link to the MGA site associated with the object. The MGA site responds with data that is used to customize the menu of options presented to the user in connection with that particular object.

Consider an icon representing a JPG image file. Right-clicking on the icon may yield a menu that gives the user various options presented by the operating system (e.g., delete, compress, rename), and additional options customized in accordance with data from the object's MGA site. These customized options may include, e.g.,

(a) open in 100x150 pixel format for free;

(b) open in 480x640 pixel format for ten cents;

(c) open in 960x1280 pixel format for twenty cents;

(d) purchase rights to use this image in a newsletter having a circulation of under 1000 for $1.25;

(e) display a complete listing of license options.

Clicking on options (b) or (c) initiates a commerce application through which funds are electronically transferred to the MGA site (by the above-described tokens or otherwise). In response, the MGA site responds (e.g., with TCP/IP or HTML instructions) authorizing an application on the user's computer to open the file in the requested manner. (The default application for JPG applications can then automatically be launched, or the computer may first query the user whether another application should be used instead.)

Clicking on option (d) proceeds as above, and permits full use of the image on the computer. Moreover, the MGA site sends a digital certificate to the user's computer memorializing the usage rights purchased by the consumer.

In this particular arrangement, no access control is placed on the content, e.g., by encryption, secure container technology, or the like. The nominal fees, and the ease of licensing, make it simple for the user to "do the right thing" and avoid copyright liability. In other embodiments, of course, known access control techniques can be used to limit use of the object until the requisite payment has been made.

Naturally, records of all such transactions are also logged at the MGA site.

Clicking on option (e) opens a browser window on the user's computer to a web site that presents a complete listing of license options available for that image. (The address of this web site is included in customization data relayed to the user device from the MGA site, but not explicitly shown to the user on the menu.) Through such web site, the user can select desired rights, effect payment, and receive the necessary authorization for software applications on the user's computer (or other media appliance) to open and/or process the content.

The object on which the user "clicks" needn't be an icon. It can be an image or other graphical representation. (And a "click" isn't necessary; a voice command or other signal may be used to the same effect with an audio clip or selection.)

Consider the popular merchandising of books and CDs over the internet. A JPG or other image file depicting the cover of a book, or the artwork of a CD cover, can be treated as a media object, and can include a watermarked MGA pointer. Right-clicking on such an image of a book cover could, through the MGA site, present to the user a menu of options that includes – in addition to those normally presented in conjunction with a JPG file – the following:

(a) "See the review of this book published in the New York Times on April 19, 1999"

(b) "See the list of reviews of this book at Amazon.com"

(c) "Enter your own review of this book, for posting on Amazon.com"

(d) "See today's sales rank of this book at Amazon.com"

(e) "Purchase this book from Amazon.com for $16.95"

(f) "Purchase this book from Barnesandnoble.com for $19.95 and receive a $5.00 credit towards your next purchase"

(g) "Link to the web site that tells about the release of this title as a motion picture (presently scheduled to open on October 10, 1999)"

(h) "Link to the Yahoo listing of web sites relating to this book"

(i) "Search Lycos for listings relating to this book."

If the user selects one of the purchase options from the menu, a pre-stored e-commerce profile -- containing the user name, credit card number, billing address, ship-to address, etc., possibly in the form of an encrypted object -- could be sent to the MGA site (or to the bookseller) to effect the purchase, or such selection could initiate display of additional screens or sub-menus through which the user would manually enter or select such information for transmission.

Others of the selections cause a new browser window to open on the user's computer, opening to a URL specified in data relayed from the MGA site but not displayed to the user in the menu. Appropriate HTML instructions can be generated to effect a particular query or other operation at the specified URL.

In some embodiments, the customized menu presents only a single choice in addition to those normally provided by the operating system, e.g., "Link to home." Clicking on this option opens a browser window to a home page at the MGA for that object. On that page, the user is presented with all of the foregoing options, and more (possibly including advertising graphics or multi-media). Such objects can serve as powerful marketing agents. Returning to the example discussed above, a JPG image file of a book cover may have, as its MGA, a web page hosted by a particular bookseller, providing purchase options and other information for that book. Marketing of books (or CDs, or cars, or consumer appliances, or virtually anything else) can be effected by disseminating such vendor-issued JPGs as widely as possible. Some book cover JPGs may be distributed by Amazon.com, others by Barnes&Noble.com, others by Borders.com

– each pointing back to a different MGA through which purchase transactions for that book may be performed.

Returning to the MGA-customized menus, these needn't be limited to menus resulting from clicking on an icon or image (or signaling during an audio excerpt). Drop-down menus in application programs can likewise be populated with customized options, in accordance with customization data obtained from the MGA site for the object presently being accessed or used. Most graphical operating systems and application programs have well developed toolsets permitting such menu customization. Again, other data relayed from the MGA site is not shown to the user, but is employed by the computer (e.g., a browser program) to carry out menu options selected by the user.

Again the foregoing techniques are equally applicable for still images, audio, video, and other forms of content, and can readily be adapted for use both with general purpose computers, software applications, and specialized media appliances.

While, for expository convenience, the foregoing discussion contemplated embedding a literal URL address in the object as the MGA, more typically this is not the case. Instead, the MGA more commonly comprises identification data for the object (e.g. a 128-bit random ID), together with the URL for a name server computer that serves many (perhaps millions) of such objects (an example of the latter is the Digimarc MarcCentre server).

To obtain the desired data as detailed above, the user's computer (sometimes termed a client computer) links to the name server computer and provides the ID of the object being processed. The name server computer uses this ID to query a database, and obtains from the database the current IP address to which such queries should be routed. The name server computer can relay the request from the client computer to the correct destination address, or can return the correct destination address to the client computer, which can initiate such a link itself. By such arrangement, the IP address ultimately associated with an object can be easily changed as needed, simply by changing the corresponding record in the name server database, without rendering obsolete legacy objects having out-of-date addresses encoded therein.

In some embodiments, the URL of the name server needn't be included in the watermark. In the absence of a specified URL, the client computer may direct such links to a default name server address instead (stored locally or remotely). If that server doesn't recognize the object ID, it can return an error code, or pass the query on to other name servers. Those servers, in turn,

can pass the query along to still other name servers if they don't recognize the object ID. In this fashion, an exponentially-large number of name servers might be quickly polled for information relating to the identified object. Alternatively, rather than encoding the complete IP address of the name server in an object watermark, the first N (e.g., 16) bits of the object ID might be used as a short-hand for one of 65,536 predetermined name server addresses, in accordance with data stored locally (e.g., on RAM or disk in the user's computer) or remotely (e.g., at a default name server IP address).

While the basic concept idea behind embedding MGA data within an object is to point to a repository of data about the object, a pointer the other way may be achieved as well.

As noted, the "ping" application of MGA data permits an MGA site to be informed of sites through which its object passes. More generally, the MGA site can log the originating address of each query it receives. Each such address can be presumed to have (or have had) a copy of the corresponding object. Media owners can thereby track the dissemination of copies of their media objects – at least insofar as use of such objects entails communicating with the associated MGA site.

Such tracking offers a great number of opportunities, some in the area of commerce. The MGA site corresponding to the cover art of a Garth Brooks CD, for example, can provide a listing of IP addresses of persons interested in that CD. Email or promotional data objects (e.g., audio clips) can be sent to that list of addresses when a subsequent Garth Brooks CD is released.

Such tracking also opens up a new dimension of internet searching. Presently, internet search engines use a brute force approach, visiting millions of pages across the web in order to identify, for example, a dozen instances of a given photograph file. MGAs offer a shortcut to such brute force approaches. With the present technology, a search engine can find a single instance of a photograph file and, by detection of the MGA data watermarked therein, link to the corresponding MGA site. From the MGA site, the search engine can obtain a listing (if such queries are authorized) of some or all of the other sites known by the MGA site to have copies of that photograph file. (Providing such data to search engines is a commerce opportunity for such MGA sites, which may permit such access to its listing of sites only in exchange for a fee. Or the MGA site may arrange to collect a tribute payment from the search engine proprietor each time the engine responds to a user query using data collected from the MGA site.)

Many of the addresses logged by the MGA may not be publicly-accessible data stores. The search engine can check each listed address to ensure that the desired object is present and accessible before adding the address to its database.

Covert Tracing

Co-pending application 09/185,380 describes anti-counterfeiting technology that looks for the presence of digital data corresponding to bank note imagery in a computer system, and makes a covert record of any attempt to process such data (e.g., Scan, FileOpen, FileSave, Print, Edit, etc.). Such records are hidden from the user of the system (using, e.g., various data encryption and obscuring techniques), but authorized law enforcement officials are provided tools by which these records can be recovered. The forensic data thereby obtained may prove useful in prosecuting counterfeiters. (Knowledge that a computer may be covertly storing evidence of attempted counterfeiting actions may prove as, or more, valuable in deterring counterfeiting than the covert records themselves.)

The same techniques can be employed to deter unauthorized processing of audio, image, video, or content by media pirates. In one embodiment, a computer's operating system (including peripheral device drivers) monitors various data within the system (e.g., data sent to writeable storage media, or sent via a serial port or network connection, etc.) for data bearing a do-not-copy watermark. The presence of such data being sent, e.g., to a writeable disk or to a remote computer, indicates that the do-not-copy instruction has been circumvented. In such case, the operating system writes one or more covert records memorializing the activity, for possible use in criminal prosecution if the computer is lawfully seized.

The example just-provided is but one of many monitoring and response techniques that may be employed to deter circumvention of copy-protection or other access control systems. Generally speaking, if content data is found where it shouldn't be, or is found used as it shouldn't be used, a corresponding record should be made. (Other intervention actions can be triggered as well; covert tracing is desirably just one of several parallel responses to suspected hacking.)

Meta-Data Accessed Using Watermarks

Meta-data, in formats known as XML, SGML, and HTML, is widely used to communicate information about digital objects (e.g., author, keywords, price, rights, caption, etc.). More generally, meta-data can be thought of as any data construct which associates the name of a property (e.g., "author), with the value of the property (e.g., "Mark Twain"). Such data commonly appears in a tag format, such as the following:

<META NAME="author" CONTENT="Mark Twain">

Meta-data is commonly exchanged between server and client computers in conjunction with the digital objects to which they relate (e.g., the text of a Mark Twain book).

As detailed herein, an important application of watermarking is likewise to convey information about media – in this case embedded within the media content itself (e.g., providing unique identification, establishing some basic behaviors such as do not copy, and providing links to extended functionality).

For meta-data to be useful, it must be linked to associated content, whether in the context of a browser, application program, operating system, asset management system, search engine, etc. However, as detailed below, the content and the associated meta-tags needn't always be conveyed together.

Consider an application program or other client process that receives a watermarked media object. The watermark includes an MGA for that object (which, as noted above, may not specify an ultimate IP address). Stored at the MGA site is meta-data corresponding to the object. By linking to the MGA site identified by the object's watermark, the client computer can obtain the meta-data corresponding to the object. This data can be stored at the client computer and used just as any other meta-data, e.g., to define the local functions that should be available for use with that object (e.g., buy, search, etc.)

A particular example is an on-line catalog of stock photography. Each photograph is watermarked with MGA data. To identify the photographer, copyright date, price, telephone number, subject, etc., an application program can link to the MGA site for that photograph, and obtain the corresponding meta-data. This data can then be displayed or used as needed. Data objects of disparate formats thus can readily be handled within a single, simple application program, since the program needn't concern itself with the varying formats for the associated

meta-data (assuming the name servers provide this data in standardized format). Substantial flexibility in programming and object formatting is thereby achieved.

Returning to the internet search engine example described above, MGAs may become recognized as repositories rich in meta-data for media objects. Specialized search engines may focus their data collection around such sites, and be able to quickly identify the MGA sites corresponding to various boolean combinations of meta-tag parameters.

Asset Management/Containers

Much has been written on the topic of asset rights management. Sample patent documents include U.S. Patents 5,892,900, 5,715,403, 5,638,443, 5,634,012, 5,629,980 and laid-open European application EP 862,318. Much of the technical work is memorialized in journal articles, which can be identified by searching for relevant company names and trademarks such as IBM's Cryptolope system, Portland Software's ZipLock system, the Rights Exchange service by Softbank Net Solutions, and the DigiBox system from InterTrust Technologies.

An exemplary asset management system makes content available (e.g. from a web server, or on a new computer's hard disk) in encrypted form. Associated with the encrypted content is data identifying the content (e.g. a preview) and data specifying various rights associated with the content. If a user wants to make fuller use of the content, the user provides a charge authorization (e.g. a credit card) to the distributor, who then provides a decryption key, allowing access to the content. (Such systems are often realized using object-based technology. In such systems, the content is commonly said to be distributed in a "secure container.")

Desirably, the content should be marked (personalized/serialized) so that any illicit use of the content (after decryption) can be tracked. This marking can be performed with watermarking, which assures that the mark travels with the content wherever -- and in whatever form -- it may go. The watermarking can be effected by the distributor – prior to dissemination of the encrypted object – such as by encoding a UID that is associated in a database with that particular container. When access rights are granted to that container, the database record can be updated to reflect the purchaser, the purchase date, the rights granted, etc. An alternative is to include a watermark encoder in the software tool used to access (e.g. decrypt) the content. Such an encoder can embed watermark data in the content as it is released from the secure container, before it is provided to the user. The embedded data can include a UID. This UID can be

assigned by the distributor prior to disseminating the container. Alternatively, the UID can be a data string not known or created until access rights have been granted. In addition to the UID, the watermark can include other data not known to the distributor, e.g. information specific to the time(s) and manner(s) of accessing the content.

As noted earlier, access rights systems can be realized with watermarks without containers etc. For example, in a trusting world, copyrighted works can be freely available on the web. If a user wishes to make lawful use of the work, the user can decode its watermark to determine the work's terms and conditions of use. This may entail linking to a web site specified by the embedded watermark (directly, or through an intermediate database), which specifies the desired information. The user can then arrange the necessary payment, and use the item knowing that the necessary rights have been secured.

Remote Reconfiguration of Watermark Detectors

In some cases, it is desirable to reconfigure watermark detectors remotely. Such functionality is desirable, for example, if a watermark system is hacked or otherwise compromised.

In accordance with this aspect of the present invention, some aspect of a watermark detector's operation is changed in response to a command. The change can take various forms. In watermark systems employing pseudo-random key data (e.g., spread spectrum spreading signals), the pseudo-random signal used for detection can be changed. In systems using DFT processing, the mapping between message bits and DFT coefficients can be changed. In still other systems, the decoding can proceed as before, but the significance of one or more bits can be changed (e.g., bits that were normally interpreted as defining Field A can be interpreted as defining Field B, and vice versa). In yet other systems, the decoding can proceed as before, but the response of a device to a given watermark signal can be changed. In still other systems, a set of software instructions can be re-written or re-ordered to effect a change in detector operation.

The command can be conveyed in various ways. In one embodiment, it can be a trigger bit in the watermark payload. Normally the bit has a value of "0." If the bit has a value of "1," the detector system responds by changing its operation. A trigger pattern can also be established, so that detection of a certain combination of bits in the watermark payload serves to trigger the change. Reserved states of certain data fields are examples of patterns that might be employed.

The command can also be conveyed through another channel different than the watermark channel (e.g., an SCA channel of an FM broadcast, or the sub-titling data channel of video broadcasts, or header data within an MPEG data stream, etc., etc.).

The change can proceed in accordance with a pre-programmed rule (e.g., codes progressing successively through a numerically or algorithmically-determined progression), or the change can proceed in accordance with data specified elsewhere in the payload of the watermark bearing the trigger bit (e.g., instead of being interpreted in normal fashion, the non-trigger bits of the detected watermark can define a new pseudo-random key data. Or the change can proceed in accordance with data conveyed in successively-presented watermark payloads, as might be done in video encoding where each frame of video can convey further watermark information. (This latter arrangement is one offering a high-bandwidth re-programming channel through which, e.g., extensive firmware instructions might be transferred to the detector to replace instructions earlier stored.)

By such arrangements, greatly increased detector versatility and functionality can be achieved.

Conclusion

Many diverse embodiments are reviewed above – each with a unique set of features. (Still others are disclosed in the assignee's patents incorporated by reference.) This specification should be construed as explicitly teaching that features illustrated in one such embodiment can generally be used in other embodiments as well. Thus, for example, a date field was not particularly discussed in connection with payload data for video watermarking. Nor were "play once" watermarks so-considered. The inclusion of a calibration signal with (or as part of) the watermark is shown in embodiments of the issued patents, but is not belabored in the above-described embodiments. Likewise with "simple universal codes." The pre-stored commerce profile described in one of the foregoing embodiments is equally applicable to other embodiments as well. Likewise, the presentation of advertising was discussed in connection with one embodiment but not others, although it, too, is generally applicable. All of these concepts are familiar at Digimarc and are regarded as generally applicable throughout the work expressed in Digimarc's patent disclosures. Practicality prevents an exhaustive recitation of each individual permutation and combination.

Having described and illustrated the principles of our invention with reference to illustrative embodiments, it will be apparent that the detailed arrangements can be modified in arrangement and detail without departing from such principles.

For example, while reference has been made to various uses of wireless, it should be understood that such reference does not just cover FM broadcast, and wireless internet networking and the like, but also includes other wireless mechanisms. Examples include cell phones and direct satellite broadcast.

Likewise, while certain embodiments were illustrated with a watermark payload of 100+ bits, in other systems much smaller (or sometimes larger) payloads are desirable – sometimes as small as 1-8 bits.

While the foregoing examples have each been illustrated with reference to a particular media type (e.g., video, audio, etc.), it will be recognized that the principles of each embodiment find application with the other media types as well.

Certain of the appliances contemplated above require user interfaces more sophisticated than are presently typical on such devices. The simplicity of the underlying audio appliance can be preserved, in many instances, by using a palmtop computer – coupled by infrared or otherwise – as a temporary user interface to the appliance. Some of the processing capability can likewise be off-loaded to an ancillary palmtop. (Palmtop is here meant to refer generally to any pocket-size programmable computing device.)

Unless otherwise stated, it should be understood that the digital music, video, and imagery contemplated herein is not of any particular form or format. Audio, for example, can be of various forms, both streaming and non-streaming, and of various formats (e.g. MP3, MP4, MS Audio, Windows Media Technologies, RealAudio, *.WAV, MIDI, Csound, Dolby's Advanced Audio Codec (AAC), etc.

To provide a comprehensive disclosure without unduly lengthening the present specification, applicants incorporate by reference the patent publications and applications cited herein.

We claim as our invention all such embodiments as may come within the scope and spirit of the following claims, and equivalents thereto.

WE CLAIM

1. A method comprising:

encoding digital source material to steganographically convey plural-bit auxiliary data;

passing the encoded source material to a destination through at least one intervening computer;

at said intervening computer, detecting encoded source material transmitted thereby; and

crediting a payment in response to said detection of the encoded source material, in accordance with the plural-bit auxiliary data steganographically conveyed by the encoded source material.

2. The method of claim 1 which includes decoding plural-bit auxiliary data only from source material that has first been tested to indicate the likely presence of such auxiliary data therein.

3. The method of claim 2 which includes testing objects by reference to an encoding attribute that is supplemental to said encoded plural-bit auxiliary data.

4. The method of claim 3 in which said attribute is the presence of a characteristic signature signal conveyed by said object.

5. The method of claim 4 in which the signature signal is a repetitive noise burst signal.

6. The method of claim 1 in which said transmitting includes distributing through a network of interconnected computers.

7. The method of claim 1

reporting said detection to a location remote from detection over same network

crediting royalties based on detection

8. A method comprising:

encoding audio source material to steganographically convey plural-bit auxiliary data;

presenting the audio source material to a consumer;

decoding the audio source material as it is being presented to the consumer, to decode the auxiliary data therefrom; and

storing data indicating the audio source material(s) presented to the consumer.

9. The method of claim 8 that includes generating a report based on the stored data, indicating the audio source material(s) presented to the consumer.

10. The method of claim 8 which includes detecting the presented audio source material with a microphone, and decoding the auxiliary data from a microphone output signal.

11. A method comprising:

encoding an object to steganographically convey plural-bit auxiliary data;

distributing the object beyond the control of a proprietor thereof;

thereafter, decoding the plural-bit auxiliary data from the object;

consulting a registry to determine the proprietor of the object, by reference to said decoded plural-bit auxiliary data; and

making a payment to said proprietor.

12. The method of claim 11 that includes making said payment through the registry.

13. The method of claim 11 in which the object is a work of authorship, and the encoding adds a generally imperceptible level of noise to the object as it is perceived by a consumer thereof.

14. The method of claim 11 in which the registry comprises a database accessible through the internet.

15. A method of encoding a digital object, comprising:

encoding the object with a first information signal, said first information signal having relatively small information content, but permitting rapid decoding; and

encoding the object with a second information signal, said second information signal conveying having relatively high information content, requiring relatively more time to decode.

16. The method of claim 15 in which the first information signal is a signal indicating to decoding equipment that the object is not to be copied, and the second information signal is a signal conveying information relating to ownership of the object.

17. The method of claim 15 in which:

the digital object is a digital representation of music; and

the first information signal is a broadband, repetitive signal that is conveyed at a low level within said music.

18. The method of claim 15 in which the first and second signals are independent of each other.

19. The method of claim 15 in which the first and second signals are aspects of a combined signal.

20. A method of processing an object that has been steganographically encoded with first and second information signals, the first information signal having relatively small information content, the second information signal having relatively larger information content, the method comprising:

decoding from the object the first information signal, the relatively small information content of the first information signal permitting relatively rapid decoding;

disabling an operation of an apparatus in accordance with the decoded first information signal; and

optionally, decoding from the object the second information signal, the relatively larger information content of the second information signal requiring relatively more time to decode, said second information signal conveying information relating to ownership of the object.

21. A method of encoding audio with a marker signal indicating a restriction on permitted copying, wherein the marker signal is characterized by being in-band, broadband, and repetitive.

22. A method comprising:

watermarking plural-bit binary payload data in an object;

reading the payload data from the object using a device; and

using the payload data read by the device in connection with a commercial transaction involving music related to said object.

23. The method of claim 11 in which the object is a poster having artwork thereon.

24. The method of claim 11 in which the object is a storage medium having a music video recorded thereon.

25. The method of claim 11 in which the device is a handheld, battery powered device.

26. A method of altering music data to steganographically insert plural bits of watermark data therein, characterized by inserting a first group of said bits for benefit of an end-user of the music data, inserting a second group of bits different than the first for benefit of an artist whose music is encoded by said music data, and inserting a third group of bits different than the first two for benefit of a distributor of the music data.

27. The method of claim 26 in which the first group of bits represents an internet address of a web site that may be accessed by end-users of the music data.

28. The method of claim 26 in which the second group of bits includes bits representing a unique identifier for the music data, permitting machine identification of the data and royalty credit to the artist.

29. The method of claim 26 in which the third group of bits represents usage restrictions to which audio appliances are responsive, thereby driving distribution of additional copies of the music data.

WATERMARK-BASED PERSONAL AUDIO APPLIANCE

09/476686
12-30-9

Related Application Data

This application is a continuation-in-part of application 60/134,782, filed May 19, 1999, attached hereto as Appendix A.

The technology detailed in the present application is also related to that detailed in copending applications 09/343,104, filed June 29, 1999; 09/292,569, filed April 15, 1999; 09/314,648, filed May 19, 1999; 60/141,763, filed June 30, 1999; 60/158,015, filed October 6, 1999; 60/163,332, filed November 3, 1999; 60/164,619, filed November 10, 1999; 09/452,023, filed November 30, 1999; 09/452,021, filed November 30, 1999; and in patent 5,862,260.

Introduction

16 year old Bob struts into the coffee shop down from high school with a couple of buddies, a subtle deep pound in the ambient sound track lets them know they're in the right place. The three of them instinctually pull out of their pockets their audio Birddawgs (a small hand held unit about the size and style of an auto-door-alarm device, or "fob"), and when they see the tiny green light, they smile, high five, and push the big "GoFetch" button in synchrony. That tune will now be waiting for them at home, safely part of their preferred collection and ever-so-thankfully not lost to their collective bad memory (if they even knew the name of the artist and tune title in the first place!).

33 year old Mary is at home listening to the latest batch of holiday tunes being offered up over her 2-decade-long favorite radio station. She's spent many days now half-consciously culling the tunes for that perfect arrangement for the new year's bash that she regrettably agreed to host. 10:40 AM rolls around and some new tune catches her ear, a tune she knows can work well following the jingle-cats rendition of Strawberry Fields. She half jogs over to the stereo and hits the "GoFetch" button. In a few days, she'll sit down at the computer and put together the final sound track for the gala evening ahead, her play list dutifully waiting for her shuffling instructions and desired start time.

APPENDIX B

49 year old Jack (the financial analyst) is thoroughly bored sitting in the crowded gate D23 at Dulles. Droning 20 feet up and over his head is the airport network station, currently broadcasting the national weather report. As the segue to the business segment approaches, the teaser review mentions that they'll be having a report on today's rally in the bond market and the driving forces behind it. Jack pulls out his Birddawg-enabled Palm Pilot on the off-chance they actually will have a little depth in the reporting. Indeed, as the segment plays and starts discussing the convoluted effects of Greenspan's speech to the Internet-B-Free society, he taps the "GoFetch" button, knowing that once he gets back to his main browsing environment he will be able to follow dozens of links that the airport network has pre-assigned to the segment.

The foregoing and other features and advantages of the present invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying figures.

Brief Description of the Drawings

Fig. 3 is a block diagram of a device according to one embodiment of the present invention.

Fig. 4 is a block diagram of a system in which the device of Fig. 3 may be utilized.

Detailed Description

Referring to Fig. 3, a device 10 according to one embodiment of the present invention includes a microphone 12, an A/D converter 13, a processor 14, one or more indicators 16, one or more buttons 18, a wireless interface 20, and a power source 22.

The device can be packaged in a small plastic housing, preferably as small as is practical (e.g., sized and configured to serve as a key chain ornament, perhaps akin to the Tomagatchi toys that were recently popular). The housing has one or more small holes to permit audio penetration through the housing to the microphone 12.

The processor 14 can take various forms, including a dedicated hardware device (e.g., an ASIC), a general purpose processor programmed in accordance with instructions stored in non-volatile RAM memory, etc.

The indicators 16 can be as simple as a single LED lamp, or as complex as an alphanumeric LCD or other multi-element display. In one embodiment, the indicator simply indicates when the processor has decoded a watermark in audio sensed by the microphone. More elaborate signaling techniques can of course be used, including two- or three-color LEDs that can be used to signal different states with different colors, indicators with flashing patterns or changing displays, etc.

The buttons 18 are used by the user to indicate an interest in the audio just-heard. In one embodiment, there is a single button 18, and it is emblazoned with a stylized legend that can serve as a trademark or service mark, e.g., GetIt!, GoFetch, Birddawg, something Batman-esque ("Wham," "Zappp," "Pow!!," etc.), or something more mundane (e.g., Capture).

The power source 22 can be a battery, solar cell, storage capacitor, or other source of energy suitable for powering the components of the device 10.

The wireless interface 20 serves to exchange data with a relay station 24 (Fig. 4). In one embodiment, the interface is radio-based, and provides a one-way communications channel. In other embodiments other wireless technologies can be used (e.g., IR), and/or two-way communication can be provided.

The relay station can be a cellular repeater (if the interface transmits using cellular frequencies and protocols), or a local receiver, e.g., associated with the user's computer. The relay station can also be a paging system relay station (e.g., as are used for two-way pagers), or may be a low earth orbit satellite-based repeater.

In operation, the processor monitors the ambient audio for the presence of encoded data, e.g., a digital watermark, and decodes same. If power considerations permit, the device is "always-on." In other embodiments, one of the buttons 18 can be used to awaken the device. In such other embodiments, another button-press can serve to turn-off the device, or the device can power-down after a predetermined period, e.g., of not sensing any watermarked audio.

A number of techniques for watermarking audio (and decoding same) are known, as illustrated by patents 5,862,260, 5,963,909, 5,940,429, 5,940,135, 5,937,000, 5,889,868, 5,833,432, 5,945,932, WO9939344 (corresponding to US application 09/017,145), and

WO9853565 (corresponding to US applications 08/858,562 and 08/974,920). Commercially-available audio watermarking software includes that available from AudioTrack, Verance (formerly Aris/Solana), Cognicity, Liquid Audio, and others.

The data payload encoded by the watermark (the audio-ID) may take various forms. One is a Digital Object Identifier – an ID corresponding to the standardized digital object numbering system promulgated by the International DOI Foundation (www.doi.org). Another is to include plural data fields variously representing, e.g., the name of the publisher, the name of the artist, the title of the work, the date of publication, etc., etc. Another is to encode a unique identifier (UID), e.g., of 16 – 64 bits. The UID serves as an index to a remote database where additional information (e.g., publisher, artist, title, date of publication, etc., are stored). The data transmitted from the device 10 to the relay station 24 typically includes some or all of the watermark payload data, and also includes data identifying the device 10, or its user (user-ID data). Again, this data can include several data fields (e.g. user name, audio delivery information such as email address or URL, age, gender, model of device 10, etc.). Alternatively, a serial number or other unique identifier can be used, which serves as an index to a database have a corresponding record of information relating to the user and/or device.

The audio-ID and user-ID data are typically formatted and encoded by the device 10 according to a protocol that provides error correcting, framing, and other data useful in assuring reliable transmission to the relay station, and/or for further transport.

Some embodiments of device 10 recognize just a single form of watermarking, and can understand only payload data presented in a single format. In other embodiments, the device may be capable of recognizing watermarking according to several different techniques, and with several different payload formats. This latter functionality can be achieved, e.g., by cyclically trying different decoding techniques until one that produces valid output data (e.g., by reference to a checksum or other indicia) is obtained. That decoding technique and payload interpretation can thereafter be used until valid output data is no longer obtained.

In some embodiments, the device 10 transmits data to the relay station at the moment the user presses the button 18. In other embodiments, a store-and-forward mode is used.

That is, when the user presses the button 18, the decoded watermark data is stored in memory within the device. Thereafter, e.g., when the device is coupled with a "nest" or "holster" at the user's computer (or when download capability is otherwise activated), the stored data is downloaded – either through that device or otherwise.

The infrastructure between the device 10 and delivery of the audio to its ultimate destination can take myriad forms. One is shown in Fig. 4. In this arrangement, some or all of the data received by the relay station 24 is routed through the internet 26 to a server 28. (The server 28 can be a "MediaBridge" server of the type described, e.g., in the assignee's applications 60/164,619, filed November 10, 1999, and 09/343,104, filed June 29, 1999.) Server 28 parses the data and routes some or all of it to a data repository 30 at which the audio requested by the user is stored. This repository, in turn, dispatches the audio to the user (e.g., to a computer, media player, storage device, etc.), again through the internet. (Address information detailing the destination 32 of the audio may be included in the data sent from the device 10, or can be retrieved from a database at the server 28 based on a user-ID sent from the device 10.)

In some embodiments, the repository 30 (which may be co-located with server 28, or not) includes various data beyond the audio itself. For example, the repository can store a collection of metadata (e.g., XML tags) corresponding with each stored item of audio. This metadata can be transmitted to the user's destination 32, or can be used, e.g., for rights management purposes (to limit the user's reproduction or re-distribution rights for the audio, etc.), to establish a fee for the audio, etc. One suitable metatag standard is that under development by <indecs> (Interoperability of Data in E-Commerce Systems, www.indecs.org).

The audio data can be delivered in streaming form, such as using technology available from RealNetworks (RealAudio), Microsoft (Windows Media Player), MP3, Audiobase, Beatnik, Bluestreak.com, etc. The former three systems require large (e.g., megabytes) player software on the receiving (client) computer; the latter do not but instead rely, e.g., on small Java applets that can be downloaded with the music.

Alternatively, the audio can be delivered in a file format. In some embodiments the file itself is delivered to the user's destination 32 (e.g., as an email attachment). In others, the

user is provided a URL to permit access to, or downloading of, the audio. (The URL may be a web site that provides an interface through which the user can pay for the requested music, if pre-payment hasn't been arranged.)

The user's destination 32 is typically the user's own computer. If a "live" IP address is known for that computer (e.g., by reference to a user profile database record stored on the server 28), the music can be transferred immediately. If the user's computer is only occasionally connected to the internet, the music can be stored at a web site (e.g. protected with a user-set password), and can be downloaded to the user's computer whenever it is convenient.

In other embodiments, the destination 32 is a personal music library associated with the user. The library can take the form, e.g., of a hard-disk or semiconductor memory array in which the user customarily stores music. This storage device is adapted to provide music data to one or more playback units employed by the user (e.g. a personal MP3 player, a home stereo system, a car stereo system, etc.). In most installations, the library is physically located at the user's residence, but could be remotely sited, e.g. consolidated with the music libraries of many other users at a central location.

The personal music library can have its own internet connection. Or it can be equipped with wireless capabilities, permitting it to receive digital music from wireless broadcasts (e.g. from a transmitter associated with the server 28). In either case, the library can provide music to the user's playback devices by short-range wireless broadcast.

In many embodiments, technology such as that available from Sonicbox, permits audio data delivered to the computer to be short range FM-broadcast by the user's computer to nearby FM radios using otherwise-unused radio spectrum.

Some implementations of the present invention support several different delivery technologies (e.g., streaming, file, URL), and select among them in accordance with the profiles of different users.

Payment for the audio (if needed) can be accomplished by numerous means. One is by charging of a credit card account associated with the user (e.g., in a database record corresponding to the user-ID).

Some implementations of the invention make use of secure delivery mechanisms, such as those provided by InterTrust, Preview Systems, etc. In addition to providing secure containers by which the audio is distributed, such systems also include their own secure payment facilities.

By such arrangements, a user can conveniently compile an archive of favorite music – even while away from home.

To provide a comprehensive disclosure without unduly lengthening this specification, the disclosures of the applications and patents cited above are incorporated herein by reference.

Having described and illustrated the principles of my invention with reference to a preferred embodiment and several variations thereof, it should be apparent that the detailed embodiment is illustrative only and should not be taken as limiting the scope of my invention.

For example, while the invention is illustrated with reference to a button that is activated by the user to initiate capture of an audio selection, other interfaces can be used. For example, in some embodiments it can be a voice-recognition system that responds to spoken commands, such as "capture" or "record." Or it can be a form of gesture interface.

Likewise, while the invention is illustrated with reference to a stand-alone device, the same functionality can be built-into radios (including internet-based radios that receive wireless IP broadcasts), computer audio systems, and other appliances. In such case the microphone can be omitted and, in some cases, the wireless interface as well. (The data output from the device can be conveyed, e.g., through the network connection of an associated computer, etc.)

Moreover, while the invention is illustrated with reference to an embodiment in which audio, alone, is provided to the user, this need not be the case. As in the Dulles airport scenario in the introduction, the server 28 can provide to the user several internet links associated with the sensed audio. Some of these links can provide commerce opportunities (e.g., to purchase a CD on which the sensed audio is recorded). Others can direct the user to news sites, concert schedules, fan-club info, etc. In some such embodiments, the ancillary information is provided to the user without the audio itself.

Although not particularly detailed, the data provided to the user's destination typically includes information about the context in which the data was requested. In a simple case this can be the time and date on which the user pressed the Capture button. Other context information can be the identification of other Birddawg devices 10 that were nearby when the Capture button was pressed. (Such information can be gleaned, e.g., by each device transmitting a brief WhoAmI message periodically, receiving such messages from other nearby devices, and logging the data thus received.)

Still other context information might be the location from which the Capture operation was initiated. This can be achieved by decoding of a second watermark signal, e.g., on a low level white-noise broadcast. The public address system in public places, for example, can broadcast a generally-indiscernable noise signal that encodes a watermark signal. Devices 10 can be arranged to detect two (or more) watermarks from the same audio stream, e.g., by reference to two pseudo-random sequences with which the different watermarks are encoded. One identifies the audible audio, the other identifies the location. By such an arrangement, for example, the device 10 can indicate to the server 28 (and thence to the user destination 32) the location at which the user encountered the audio. (This notion of providing location context information by subliminal audio that identifies the location has powerful applications beyond the particular scenario contemplated herein.)

In some embodiments, the device 10 can buffer watermark information from several previous audio events, permitting the user to scroll back and select (e.g., in conjunction with a screen display 16) the ID of the desired audio.

An arrangement like the foregoing may require that the decoded watermark information be interpreted for the user, so that the user is not presented simply a raw binary watermark payload. The interpreted information presented to the user can comprise, e.g., the source (CNN Airport News, WABC Radio, CD-ROM, MTV), the artist (Celine Dion), the title (That's the Way It Is), and/or the time decoded (3:38:02 p.m.), etc.

One way to achieve the foregoing functionality is to convey both the binary UID payload and abbreviated text (e.g., 5- or 6-bit encoded) through the watermark "channel" on the audio. In one such arrangement, the watermark channel conveys data a UID, four

characters of text, and associated error-correcting bits, every ten seconds. In the following ten seconds the same UID is conveyed, together with the next four characters of text.

Another way to achieve such functionality is to provide a memory in the device 10 that associates the watermark payload (whether UID or field-based) with corresponding textual data (e.g., the source/artist/title referenced above). A 1 megabyte semiconductor non-volatile RAM memory, for example, can serve as a look-up table, matching code numbers to artist names and song titles. When the user queries the device to learn the identify of a song (e.g., by operating a button 18), the memory is indexed in accordance with one or more fields from the decoded watermark, and the resulting textual data from the memory (e.g. source/artist/title) is presented to the user.

Such a memory will commonly require periodic updating. The wireless interface 20 in device 10 can include reception capabilities, providing a ready mechanism for providing such updated data. In one embodiment, the device "awakens" briefly at otherwise idle moments and tunes to a predetermined frequency at which updated data for the memory is broadcast, either in a baseband broadcast channel, or in an ancillary (e.g. SCA) channel.

In variants of the foregoing, internet delivery of update data for the memory can be substituted for wireless delivery. For example, a source/artist/title memory in the device 10 can be updated by placing the device in a "nest" every evening. The nest (which may be integrated with a battery charger for the appliance) can have an internet connection, and can exchange data with the device by infrared, inductive, or other proximity-coupling technologies, or through metal contacts. Each evening, the nest can receive an updated collection of source/artist/title data, and can re-write the memory in the device accordingly. By such arrangement, the watermark data can always be properly intepreted for presentation to the user.

The "Capture" concepts noted above can be extended to other functions as well. One is akin to forwarding of email. If a consumer hears a song that another friend would enjoy, the listener may send a copy of the song to the friend. This instruction can be issued by pressing a "Send" button, or by invoking a similar function on a graphical (or voice- or gesture-responsive) user interface. In response, the device so-instructed can query the person as to the recipient. The person can designate the desired recipient(s) by scrolling through a

pre-stored list of recipients to select the desired one. (The list can be entered through a computer to which the device is coupled.) Alternatively, the user can type-in a name (if the device provides a keypad), or a portion thereof sufficient to uniquely identify the recipient. Or the person may speak the recipient's name. As is conventional with hands-free vehicle cell phones, a voice recognition unit can listen to the spoken instructions and identify the desired recipient. An "address book"-like feature has the requisite information for the recipient (e.g., the web site, IP address, or other data identifying the location to which music for that recipient should stored or queued, the format in which the music should be delivered, etc.) stored therein. In response to such command, the appliance dispatches instructions to the server 28, including an authorization to incur any necessary charges (e.g., by debiting the sender's credit card). Again, the server 28 attends to delivery of the music in a desired manner to the specified recipient.

Still further, a listener may query the device (by voice, GUI or physical button, textual, gesture, or other input) to identify CDs on which the ambient audio is recorded. Or the listener may query the device for the then-playing artist's concert schedule. Again, the appliance can contact a remote database and relay the query, together with the user ID and audio ID data. The database locates the requested data, and presents same to the user – either through a UI on device 10, or to the destination 32. If desired, the user can continue the dialog with a further instruction, e.g., to buy one of the CDs on which the then-playing song is included. Again, this instruction may be entered by voice, GUI, etc., and dispatched from the device to the server, which can then complete the transaction in accordance with pre-stored information (e.g. credit card account number, mailing address, etc.). A confirming message can be relayed to the device 10 or destination 32 for presentation to the user.

While the invention particularly contemplates audio, the principles detailed above find applications in many other media, and in many other applications of the MediaBridge server 28.

Moreover, while the invention particularly contemplates watermarks as the channel by which audio is identified, in other embodiments different techniques can be used. For example, digital radio protocols provide ID fields by which audio can be identified. Similarly, IP protocols for internet delivery of radio include identification fields within their

packet formats. Accordingly, audio distributed according to formats that include audio IDs therein can likewise be employed according to the present invention.

In view of the many embodiments to which the principles of my invention may be applied, it should be apparent that the detailed embodiment is illustrative only and should not be taken as limiting the scope of the invention. Rather, I claim as myr invention all such modifications as may fall within the scope and spirit of the following claims, and equivalents thereto.

I CLAIM:

1. A device comprising a housing sized for carrying in a user's pocket and including:

a transducer to receive ambient audio and to output electrical signals corresponding thereto;

a watermark detector coupled to the transducer for producing payload information;

a memory storing user identification information; and

an interface that receives at least some of both the payload information and the user identification information for transmission to a relay station.

2. The device of claim 1 in which the interface is a wireless interface.

3. The device of claim 1 including an alphanumeric display.

4. The device of claim 1 including a keypad.

6. A method comprising:

receiving audio at a device;

discerning from the audio a plural-bit audio ID;

obtaining a user ID from a memory in the device;

transmitting at least portions of both the audio ID and the user ID to a location remote from said device.

7. The method of claim 6 in which the audio ID comprises a Digital Object Identifier.

8. The method of claim 6 that further comprises receiving the audio by a microphone.

9. The method of claim 8 that further comprises discerning at least two IDs from the audio, one being said audio ID, another being an ID corresponding to an environment in which the device is located.

10. In a method of steganographically encoding audio with a plural-bit binary watermark payload, an improvement wherein the watermark payload comprises a Digital Object Identifier.

11. A method comprising generating a noise-like signal having a plural-bit location identifier encoded therein, and airing said signal through at least one loudspeaker in an environment, said aired signal being generally indiscernible by human listeners present in said environment.

DATA TRANSMISSION BY WATERMARK PROXY

Related Application Data

This application is a continuation-in-part of copending application _____, filed January 26, 2000, entitled Data Transmission by Watermark Proxy, attorney docket 60099, which is a continuation-in-part of copending application 09/473,396, filed December 28, 1999 entitled Watermark-Based Object Linking and Embedding, the disclosure of which is attached as Appendix A. This application is also a continuation-in-part of copending application 09/476,686, filed December 30, 1999, entitled Watermark-Based Personal Audio Appliance, the disclosure of which is attached as Appendix B. This application is also a continuation in part of copending application 60/134,782, filed May 19, 1999, the disclosure of which is attached as Appendix C.

Field of the Invention

The present invention relates to data transmission, and more particularly relates to use of watermarks as proxies for data in transmission.

Summary of the Invention

As detailed in the assignee's prior applications, including 60/134,782, 60/141,538, and 09/343,104, digital watermark technology has numerous applications beyond its traditional role of simply communicating copyright information. One futuristic view foresees that all "content" should be watermarked, thereby enabling a great variety of operations and transactions whenever watermarked content is processed by digital devices equipped with watermark recognition and reading technology. All physical media objects can thereby be inherently and persistently digitally-enabled, permitting greatly simplified access to networks and execution of local and remote applications. The continuing growth of the Internet and beginnings of trends toward pervasive computing signal an opportunity to radically change the relationships between traditional media content and digital processing environments.

In this specification, content refers not just to electronic audio, image, and video files, but also includes the content aspects of physical objects and media, e.g., artwork, patterns, and labels on product packaging, concert tickets, etc.

In accordance with a preferred embodiment of the present invention, the processing of watermark data as pointer to shared resources is sometimes used in lieu of transmitting from point to point the object with which it is associated, thereby gaining efficiencies in speed and bandwidth.

This and other features and advantages of the present invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a diagram illustrating a network environment in which principles of the present invention may be employed.

Fig. 2 is a flow chart illustrating aspects of one embodiment of the present invention.

Fig. 3 is a flow chart illustrating aspects of another embodiment of the present invention.

Fig. 4 is a flow chart illustrating aspects of yet another embodiment of the present invention.

Detailed Description

Referring to Fig. 1, consider an exemplary network 10 linking two devices – a first device 12 associated with an originating user, and a second device 14 associated with a recipient user. The first device 12 is coupled to the network through a relatively low bandwidth channel, whereas the second device 14 is coupled to the network through a relatively high bandwidth channel. (For example, the first device may be an internet-capable cell phone having low resolution-, still image only- capture capabilities, providing a 9600 baud data channel, or it may be a home PC, with an associated PC or digital single shot camera, coupled to the internet with a 28.8 kbps modem. The second

device may be a computer coupled to the internet through a 1.45 megabit per second T-1 line, a cable modem, etc.) The network 10 connecting the two devices includes various links – narrow bandwidth at some parts (e.g., 16), very broadband at other (e.g., internet backbone 18), etc.

Assume the user of device 12 encounters a printed image, e.g., an advertisement in a magazine, that may be of interest to the user of device 12. Using an imaging device (e.g., a CMOS- or CCD-camera built into a cell phone, a flatbed scanner connected to a PC, etc.), device 12 captures an image of the advertisement.

In prior art techniques, the image captured by device 12 would have been sent to device 14 over the network; the image received by the second device would be exactly the image sent by the first device.

In accordance with one embodiment of the invention, device 14 receives a better image than that sent from device 12. In one such embodiment, device 14 receives the image data captured by device 12. Device 14 recognizes that the image includes a watermark hidden within the image data, and decodes same. The watermark payload includes an index by which a copy of the image can be accessed from a server 20 on the internet or other storage medium. With this index, the second device 14 queries the server 20, which returns the image corresponding to this watermark index (in this case, the advertisement) back to the second device 14. The image provided by the server can be higher resolution or pristine, i.e., it has no artifacts left from scanning at device 12, etc. Such a procedure is shown by the flowchart of Fig. 2.

The watermark payload identifying the sensed image can as long or as short as the application requires. Typically, payloads of between 16 and 64 bits are used, although this is not essential. Shorter payloads have the advantage that they can be more robustly encoded while maintaining a fixed degree of image quality; longer payloads offer a greater universe of identifiers with which the image can be labeled. Illustrative watermarking technology is detailed in the assignee's patent 5,862,260, and in copending application _____, filed February 14, 2000, entitled Watermark Embedder and Reader (attorney docket 60112). A great variety of other watermarking arrangements may

be used, including those proposed in patents 5,930,369, 5,933,798, 5,664,018, 5,825,892, 5,940,429 and 5,889,868.

In accordance with another embodiment of the invention (Fig. 3), the bandwidth bottleneck imposed by narrowband channel 16 (through which device 12 is coupled) is obviated by employing a watermark as a proxy for an image. In such an arrangement, the image data captured by device 12 is decoded, and a watermark payload hidden in the image is extracted. (This can be performed by hardware or software available in device12, e.g., a cell phone microprocessor, a desktop computer, dedicated decoder circuitry, etc. Alternatively, this decoding can be done remotely from device 12, but before device 14, e.g., by a smart router in the intervening network. In the following discussion, decoding in the device 12 is assumed.) Instead of transmitting the image data over the network, the watermark decoding device (e.g., device 12) simply transmits the watermark payload (or a part thereof). On receipt of the payload, device 14 again queries the server 20, and obtains the image (and/or additional content or functionality, as detailed below) , corresponding to that watermark. The image is obtained over the high-speed channel(s) between the server and the second device; the low bandwidth channel linking the first device conveys just the low bandwidth watermark payload information.

By building filters into the low bandwidth devices, upon recognition of a class of watermarks indicating availability of the image as a shared resource, or upon user selection of "transmit only watermark data", the image [or content associated with it via the watermark] can be made available to the message recipient via more capable transmission means.

A variant of the foregoing does not transmit the watermark payload to the second device 14. Instead, the payload is dispatched by the first device 12 (or the smart router) directly to the server 20, with instructions that the corresponding desired image be sent to the second device 14. Such an arrangement is shown in Fig. 4.

In some applications, the media delivered by the server may be richer than the simple image captured by device 12. For example, the watermark payload in the image captured by device 12 may index one or more files on server 20 that includes video, animation, sound, executable applications, aplets (e.g., JAVA, ActiveX) etc ("enhanced

content"). Thus, scanning of a magazine ad at one device can prompt delivery of a video, a Macromedia ShockWave presentation, etc., to the second device.

In some embodiments, the second device 14 identifies to the server 20 its media-playback capabilities. The server 20 can then respond to a watermark-based query with media appropriate to that particular media consumer.

One way the media capabilities of device 14 can be indicated to server 20 is by a data word comprising flag bits, with each set "1" bit indicating a capability. A simplified 8-bit capability word may be as follows:

Bit	Capability
0	GIF file display
1	TIFF file display
2	JPEG filed display
3	AVI movie display
4	WAV sound
5	RealAudio sound
6	MP3 sound
7	WindowsMedia

The data comprising this word may be automatically compiled on device 14, e.g., from the operating system database with which programs are registered on installation (the Registry database in Windows).

If device 14 sends the capability word 10101100 to server 20, the server knows the device 14 supports GIF and JPEG imagery (but not TIFF), and RealAudio and WAV sound (but not MP3 or WindowsMedia).

If server 20 has media content corresponding to the queried watermark in several supported formats, it can deliver certain ones according to a priority order (e.g., send JPEG if supported; else send GIF if supported; else send TIFF if supported).

If the server 20 only has media in a format not supported by the second device 14 (e.g., TIFF in the foregoing example), the server may invoke a conversion routine to perform an on-the-fly conversion to a supported media type (e.g., JPEG) prior to sending to the second device 14.

If the watermark index is provided by the second device 14 (rather than directly from the first device 12), the capability data word can accompany the index.

If the watermark index is provided directly from the first device 12, the server can solicit from the second device 14 a data capability word before responding to the query. Alternatively, the server can keep, on-file, a database detailing the media capabilities of all known media consumers, and can tailor its query response according to such profile. (The second device 14 can be arranged to automatically inform server 20 of updates to its capability, e.g., each time a new media playback application is registered in the registry database.)

If the server 20 does not know, and cannot discern, the media capabilities of the second device 14, it can provide media in a default form that is most likely to be acceptable (e.g., JPEG, if the content captured by the first device 12 is imagery).

From the foregoing description, it will be apparent that embodiments of the present invention provide various advantages over the prior art. One is the dispatch of high bandwidth enhanced content using a low bandwidth channel. Another is the receipt of higher-quality data than that originally captured. Another is delivering applications via low bandwidth channels to recipients by capturing images or watermark data from media content that serve as proxies for the applications.

Having described and illustrated the principles of our invention with reference to a specific embodiment, it will be recognized that the principles thereof can be implemented in other, different, forms.

For example, while the invention has been described with reference to images, the same principles are equally applicable to video and audio.

Similarly, while the foregoing description has made reference to transmitting the watermark, in many implementations only a part of the watermark need be transmitted. (The watermark may include error correcting information, or other data, not necessary to identify the corresponding data on the server 20.)

Still further, while the detailed embodiment contemplated a still or video camera system for first device 12, much of the functionality of such an image capture system isn't essential to the present invention. Instead, an input device that serves a simpler

"watermark capture" function may be used instead. Such a device can omit, e.g., hardware or software components associated with pixel interpolation (commonly used to achieve a desired virtual resolution), formatting (e.g., to provide output in JPEG form), etc. Such components serve useful functions when the resulting imagery is to be displayed or printed, but are superfluous – or detrimental – when the image data is simply to be decoded to extract watermark data.

While the invention is illustrated with reference to steganographic watermark technology for identifying the initial content (i.e., that sensed by device 12), other technologies can alternatively be used. These include data glyphs, 1- and 2-D barcodes, magnetic ink, RF ID tags, UV or IR markings, etc.

While the detailed embodiment contemplated a single server 20 to serve as the repository of content corresponding to watermarks, in other embodiments such a server is implemented in distributed fashion. In some embodiments, one server may act as a default repository, and can dispatch queries to other servers if the first server cannot provide the requested data. Caching of frequently-requested content can be provided at various locations through the network. Additional details on such network configurations can be found in application 09/343,104.

As is familiar to those skilled in the arts, the foregoing methods may be performed using dedicated hardware at devices 12, 14 and 20, and/or through use of processors programmed in accordance with firmware or software, etc. In the latter case the processors may each include a CPU and associated memory, together with appropriate input and output devices/facilities. The software can be resident on a physical storage media such as disks, and can be loaded into the processors' memory for execution. The software includes instructions causing the CPU to perform the various processes detailed above.

To provide a comprehensive disclosure without unduly lengthening this specification, applicant incorporates by reference the patents and applications cited above.

In view of the wide variety of embodiments to which the principles of our invention can be applied, it should be recognized that the detailed embodiments are illustrative only and should not be taken as limiting the scope of the invention. Rather, we claim as our invention all such embodiments as may come within the scope and spirit of the following claims, and equivalents thereto.

WE CLAIM:

1. A method comprising:

sensing a media object in human-perceptible form, and converting same to an electronic form, said sensing and converting being performed by a first device;

decoding object identification data from the electronic form;

by reference to said object identification data, identifying a set of data stored in a repository at a remote site, the set of data comprising at least one media content file; and

sending said set of data from said repository.

2. The method of claim 1 in which the object identification data comprises plural-bit watermark data steganographically encoded within the sensed media object.

3. The method of claim 2 in which the media content file represents the same media object as originally sensed, but represented with higher fidelity or accuracy.

4. The method of claim 2 in which:

the media object comprises a graphic on a printed page; and

the sending comprises sending the set of data to a second device remote from the first device.

5. The method of claim 2 in which the decoding is also performed by said first device, and the method includes sending at least a part of the watermark data from the first device.

6. The method of claim 5 which includes sending at least a part of the watermark data to a second device, the second device being remote from the first device.

7. The method of claim 6 in which the data repository comprises the second device.

8. The method of claim 7 that includes sending a destination identifier to the data repository from the first device, the data repository thereafter sending the set of data in accordance with said destination identifier.

9. The method of claim 6 in which the second device is distinct from the repository, and in which the method includes:

from the second device, accessing the repository by use of at least of a part of the watermark data; and

receiving at the second device, the set of data from the data repository.

10. The method of claim 9 which includes transmitting capability data from the second device to the repository, the capability data indicating the type(s) of media acceptable to the second device, and sending from the repository to the second device one of said types of media corresponding to said watermark data.

11. The method of claim 5 in which the sending comprises sending to a second device, the second device being remote from the first device and being distinct from the repository.

12. The method of claim 2 in which the decoding is performed by a second device remote from the first device.

13. The method of claim 2 that further comprises:

sending the electronic form of the media object to a second device remote from the first device;

decoding the watermark data from said electronic form at the second device; and

using at least part of said watermark data to access a data repository at the remote site; and

receiving, at the second device, the set of data from said data repository.

14. The method of claim 13 in which the data repository comprises the second device.

15. The method of claim 13 in which the data repository is distinct from the second device.

16. The method of claim 2 which includes decoding the watermark data at a device remote from the first device.

17. The method of claim 16 which includes sending the set of data from the repository to a second device after decoding the watermark data at a third device distinct from the first and second devices.

18. The method of claim 2 in which the media object comprises audio.

19. A method of invoking delivery of a set of data from a repository to a destination that includes:

sensing a media object in human-perceptible form, and converting same to electronic form, said sensing and converting being performed by a first device;

decoding object identification data from the electronic form; and

transmitting at least some of said decoded object identification data, without transmitting said electronic form, so as to invoke delivery of the set of data from the repository to the destination.

20. The method of claim 19 in which the object identification data comprises plural-bit watermark data steganographically encoded within the sensed media object.

21. A computer storage medium having stored thereon instructions causing a computer to perform the method of claim 19.

22. A device comprising an image sensor coupled to a watermark decoder, said device having a mode of operation in which it provides output data comprising plural-bit watermark payload information from image sensor data but not processed image output data for external use.

23. An image capture device having two modes, in the first mode said device serving as the device of claim 22, in the second mode said device providing image output data for external use.

DATA TRANSMISSION BY WATERMARK PROXY

Abstract of the Disclosure

A media object sensed at one location is delivered at a second remote location, or an application associated with the object is made available at the second location. In some embodiments, the delivered object is of a higher quality than the sensed object. In other embodiments, larger objects requiring higher bandwidth for effective transmission are delivered notwithstanding low bandwidth bottlenecks between the first and second locations. Such advantages are achieved by employing watermark data as proxies for media objects and associated applications.

WATERMARK-BASED OBJECT LINKING AND EMBEDDING

09/473,396
12/28/99

Field of the Invention

The present invention relates to data processing, and more particularly relates to use of watermark technology for object substitution.

Background and Summary of the Invention

Object linking and embedding ("OLE," sometimes also known as dynamic data exchange, or "DDE") is a well-known data processing construct by which a first digital object (e.g., a graph) can be embedded within a second digital object (e.g., a word processing document). In some embodiments, the embedding is static. That is, once the embedding takes place, subsequent changes to the first digital object (e.g., the graph) are not reflected in the second, composite digital object (e.g., the document). In other embodiments, the embedding is dynamic (and thus more commonly termed linking rather than embedding). In such arrangements, if the graph is changed, the document is automatically updated to incorporate the latest version of the graph.

The technology underlying OLE is sophisticated, but is well understood by artisans in the field. Reference may be made to the many patents (e.g., 5,581,760 and 5,581,686) and reference books (e.g., Brockschmidt, Inside OLE 2, Microsoft Press, Redmond, WA, 1994) on the subject for further details.

In accordance with the present invention, OLE-like principles are implemented using watermark data in digital objects in order to effect object linking or embedding.

In one illustrative embodiment, a photocopier scans an original paper document to produce image data. This image data is analyzed for the presence of watermark data that identifies the graphic(s) on the document. With this watermark identifier, the photocopier can query a remote image database for pristine image data corresponding to the graphic(s) on the document. This pristine data can be relayed from the remote database to the photocopier and substituted into the scanned image data. Output printed from the photocopier is thus based, at least in part, on pristine image data, rather than on image data that has been

APPENDIX A

subjected to various corruption mechanisms (e.g., degradation of the original paper document, artifacts due to scanning, etc.).

The foregoing and other features and advantages of the present invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 shows an apparatus according to one embodiment of the present invention.

Detailed Description

Referring to Fig. 1, an illustrative embodiment of the present invention is a photocopier 10. The photocopier includes a platen 12, a scanner assembly 14, a raw data memory 16, a watermark decoder 18, a processor 20, a network connection 22. a pristine image buffer 24, a compositing memory 26, and a reproduction engine 28.

A paper document, such as document 30, is placed on platen 12, and scanner assembly 14 is activated to generate scan data corresponding to the document. The scanner assembly is conventional and may include a linear array of CCD or CMOS sensor elements that optically scans along an axis of the platen to generate 2D image data. Alternatively, the scanner can comprise a 2D array of sensor elements onto which an image of the document is projected through one or more lenses. In the illustrated embodiment. the document 30 includes a picture 31 that is encoded with a plural-bit digital watermark. Document 30 may be referred to as a compound document since it incorporates plural components (e.g., text and picture).

The scan data from the scanner assembly 14 is stored in the raw data memory 16, where it is analyzed for the presence of watermark data by the watermark decoder 18.

There are many different techniques by which imagery can be digitally watermarked and decoded. One is the Digimarc watermark system detailed, e.g., in patent 5,862,260, and in pending application 09/452,023, filed November 30, 1999, the disclosures of which are incorporated herein by reference. A great variety of other systems are known. All that is

required is that the watermark permit the conveyance of plural-bit auxiliary data without objectionable image degradation.

Upon detection of the watermark in picture 31, the processor 20 is programmed to initiate communication with a remote server 32 (e.g., over the internet) through the network connection 22. The programmed processor sends to the server a query message identifying the detected watermark (which may be, e.g., an identifier of 16 – 64 bits). A database 34 at the server 32 searches its records 37 for a digital object indexed by that watermark ID 39 and, if located, causes a pristine version of the object 38 (in this case a pristine version of the picture 31) to be sent to the photocopier.

In the embodiment illustrated, the database has the pristine version of the object stored within the database record for that watermark ID, and relays same directly back to the photocopier. In other embodiments, the object itself is not stored in the database. Instead, the database stores (in a record associated with the watermark ID) the address of a remote data repository at which the pristine object is stored. In this case the object server 32 can transmit an instruction to the remote repository (e.g., again over the internet), requesting the remote repository to provide the pristine object. The object can be sent directly from the remote data repository to the photocopier, or may be relayed through the object server 32. In any case, the pristine object may be provided in TIFF, JPEG, GIF, or other format. (In some embodiment, the request signal from the photocopier specifies the format desired, or may specify plural formats that the photocopier can accept, and the pristine object is then output by the server 32 or remote repository in such a format. In other embodiments, the request signal from the photocopier does not include any format data.)

In some embodiments, the object server 32 can be of the sort more particularly detailed in copending applications 60/164,619 (filed 11/10/99), and 09/343,104 (filed 6/29/99), the disclosures of which are incorporated herein by reference.

In addition to detecting the ID of any watermark in the scanned image data, the photocopier's watermark detector also discerns the placement of the watermarked picture within the document image, and its state (e.g., size, rotation, etc.), and produces corresponding state information. In some embodiments, this state information is passed to the object server 32, permitting the pristine object 38 to be sized/rotated/etc. (e.g., by the object

server) to match the object detected in the document image. In other embodiments, a generic version of the pristine object is passed back to the photocopier, and the processor 20 attends to sizing, rotating, etc., of the pristine picture 38 as necessary to match that of the original picture 31.

In some embodiments the picture 31 in the paper document has been cropped. (The watermark can nonetheless be detected from the cropped image.) When the pristine picture 38 is received from the remote location, it can be pattern-matched to the picture 31 detected in the original document to determine the cropping boundaries (if any), and corresponding cropping of the pristine picture can be effected.

Once the foregoing scaling/rotation/cropping, etc., adjustments (if any) have been made on the pristine picture 38 stored in buffer 24, the processed pristine picture is combined with the original document scan data in compositing memory 26, yielding a composite document image that includes the pristine picture data 38 in lieu of the scanned picture 31. (The substitution of the pristine picture for the original picture data can be accomplished by various known image processing techniques, including masking, overwriting, etc.) The composite document image is then passed to the reproduction engine 28 to produce a hard-copy output (i.e., an enhanced compound document 30') in the conventional manner. (The reprographic engine 28 can take many different forms including, e.g., xerography, ink-jet printing, etc.)

The pristine picture 38 received from the server 32 can, itself, be watermarked or not. If watermarked, the watermark will usually convey the same payload information as the watermark in the original picture 31, although this need not always be the case. In other embodiments, the pristine picture 38 received from the remote server 32 has no watermark. In such case the pristine picture can be substituted into the compound document 30 in its unwatermarked state. Alternatively, the apparatus 10 can embed a watermark into the picture prior to (or as part of) the substitution operation.

If the substituted picture is watermarked, this permits later watermark-based enhancement or updating. For example, if the enhanced compound document 30' including the pristine picture 38 is printed by the photocopier, and the resulting photocopy is thereafter photocopied, the latter photocopying operation can again substitute pristine picture data for

the scanned picture data produced by the second photocopier's scanner. Moreover, in applications where it is appropriate for a picture to be updated with the latest version whenever printed, the watermarking of the picture 38 permits substitution of a latest version whenever the document is scanned for printing.

In other situations, it is desirable for the picture 38 included in the enhanced compound document 30' to be unwatermarked. This is the case, for example, in certain archival applications where it is important that the document 30' not be changed after archiving. By assuring that the picture 38 is not watermarked, inadvertent changing of the picture in subsequent photocopying can be avoided. (In cases where the pristine image 38 is provided from server 32 in a watermarked state, the photocopier may remove or disable the watermark in response to corresponding instructions from a user through a user interface or the like.)

From the foregoing, it will be recognized that the illustrative embodiment can produce "photocopies" that are better than the "originals." This is accomplished by watermark-based substitution of pristine digital objects to replace less pristine counterparts.

Having described and illustrated the principles of our invention with reference to an illustrative embodiment, it will be recognized the invention is not so limited.

For example, while the invention is particularly illustrated with reference to a photocopier, the same principles are equally applicable in other systems, including personal computers (e.g., in conjunction with image editing software, such as Adobe Photoshop). In such case the input image data needn't come from a scanner but may come, e.g., from a digital file, from a network location, etc.

Likewise, while the invention is particularly illustrated with reference to picture (i.e., graphic) data, the same principles are equally applicable in connection with other data types, such as video, sound, text, etc. Moreover, the reference to "documents" is illustrative only; the invention can similarly be employed with any compound object that includes a watermarked component – whether in digital or analog form.

While the detailed embodiment is described as using separate raw data memory 16, pristine image buffer 24, and compositing memory 26, more typically some or all of these

functions are served by a single memory, which may be a computer system's main RAM memory.

Likewise, while the detailed embodiment employs a processor 20 programmed in accordance with software instructions (e.g., stored in a memory or on a storage medium), in other embodiments some or all of the described functionality can be achieved using dedicated hardware (e.g., ASICs), or programmable hardware (e.g., PLAs).

Still further, while the invention is illustrated with reference to an arrangement in which a document includes a single watermarked photograph, it will be recognized that plural such watermarked components may be present in a compound document, and the system may be arranged to obtain pristine versions of each, and edit/composite same as necessary as to recreate an enhanced version of the original document.

Moreover, while the illustrative embodiment contemplates that a watermarked photograph may be a component of the original document, in other embodiments the watermarked object may comprise the entirety of the original document.

While reference has been made to substitution of pristine image components, in some embodiments it may be desirable to substitute components that are not "pristine." Indeed, in some embodiments an object may be substituted that is visually dissimilar to the original object. Consider artwork for a Christmas card. The artwork may include a watermarked "generic" corporate logo. When encountered by a computer according to the present invention, the generic logo may be replaced with a logo corresponding to the corporate owner of the computer. In such case, the substitute imagery may be stored within the computer itself, obviating the need for any network connection. The registry database maintained by the computer's operating system may include keys defined by watermark IDs. When a watermark ID is encountered, the registry database can be consulted to identify a corresponding graphic that can be substituted into the object being processed. If none is found, the watermark ID can be passed to the remote server 32.

While, for expository convenience, the illustrative embodiment was described as always substituting pristine data when available, more typically this is a function that would be enabled or disabled by an operator of the device, e.g., by an appropriate switch, button, or user interface control. In some embodiments, the device may be arranged to query the user

when substitution of a pristine component is possible, in some cases presenting the user with a depiction of the image component proposed to be substituted.

The illustrative embodiment may be said to employ watermark-based object embedding, since the hard-copy output is static (i.e., cannot change) after printing. In other embodiments, the enhanced compound document 30' is not printed, but stored. Each time the compound document is utilized (e.g., opened for editing, or printed), any watermarked component(s) therein can be updated to include the latest-available version(s) of the watermarked component(s). In such case, the document may be said to employ watermark-based object linking.

In view of the many embodiments to which the principles of our invention may be applied, it should be apparent that the detailed embodiment is illustrative only and should not be taken as limiting the scope of our invention. Rather, we claim as our invention all such modifications as may fall within the scope and spirit of the following claims, and equivalents thereto.

WE CLAIM

1. A system for producing an enhanced digital object comprising:

a source of original object data;

a watermark detector; and

a source of substitute data;

the aforesaid elements cooperating to permit substitution of a substitute object component for an original component found in the original object data by reference to watermark data encoded in the original object component.

2. The system of claim 1 that further comprises a printing engine having an input for receiving print data that includes the substitute object component.

3. A photocopier according to claim 2, wherein the source of original object data comprises a scanner.

4. The system of claim 1 in which the source of substitute data is located remotely from said system.

5. A method of enhancing an original digital object comprising:

recognizing a component of the original digital object having a watermark encoded therein;

by reference to said watermark, obtaining a counterpart to said component; and

substituting the counterpart into the digital object to produce an enhanced object.

6. The method of claim 5 in which the counterpart component has a watermark encoded therein.

7. The method of claim 6 that includes removing or disabling the watermark from the counterpart component before substituting.

8. The method of claim 5 in which the counterpart component does not have a watermark encoded therein.

9. The method of claim 8 that includes encoding a watermark in the counterpart component, so that the counterpart component in the enhanced object includes a watermark.

10. The method of claim 5 in which the obtaining includes transmitting a request signal to a remote server.

11. The method of claim 10 that further includes providing the substitute component from the remote server.

12. The method of claim 11 that includes directing a request to a repository remote from the server, and providing the substitute component from the remote repository.

13. The method of claim 5 that includes sizing, rotating, and/or cropping the counterpart component prior to substituting.

14. The method of claim 13 that includes sizing, rotating, and/or cropping the counterpart component at a location different than the substituting.

15. The method of claim 5 in which the substitute component is visually dissimilar from the component in the original object.

16. The method of claim 5 in which the substitute component is a graphic.

17. The method of claim 5 in which the obtaining includes consulting a registry database.

18. The method of claim 5 in which the obtaining includes obtaining from storage physically co-located with a processor that performs the method.

19. The method of claim 5 that includes repeating the method, with the enhanced object as the original object, to produce a second enhanced object.

20. A computer storage media having stored thereon instructions causing a processor to perform the method of claim 5.

WATERMARK-BASED OBJECT LINKING AND EMBEDDING

Abstract of the Disclosure

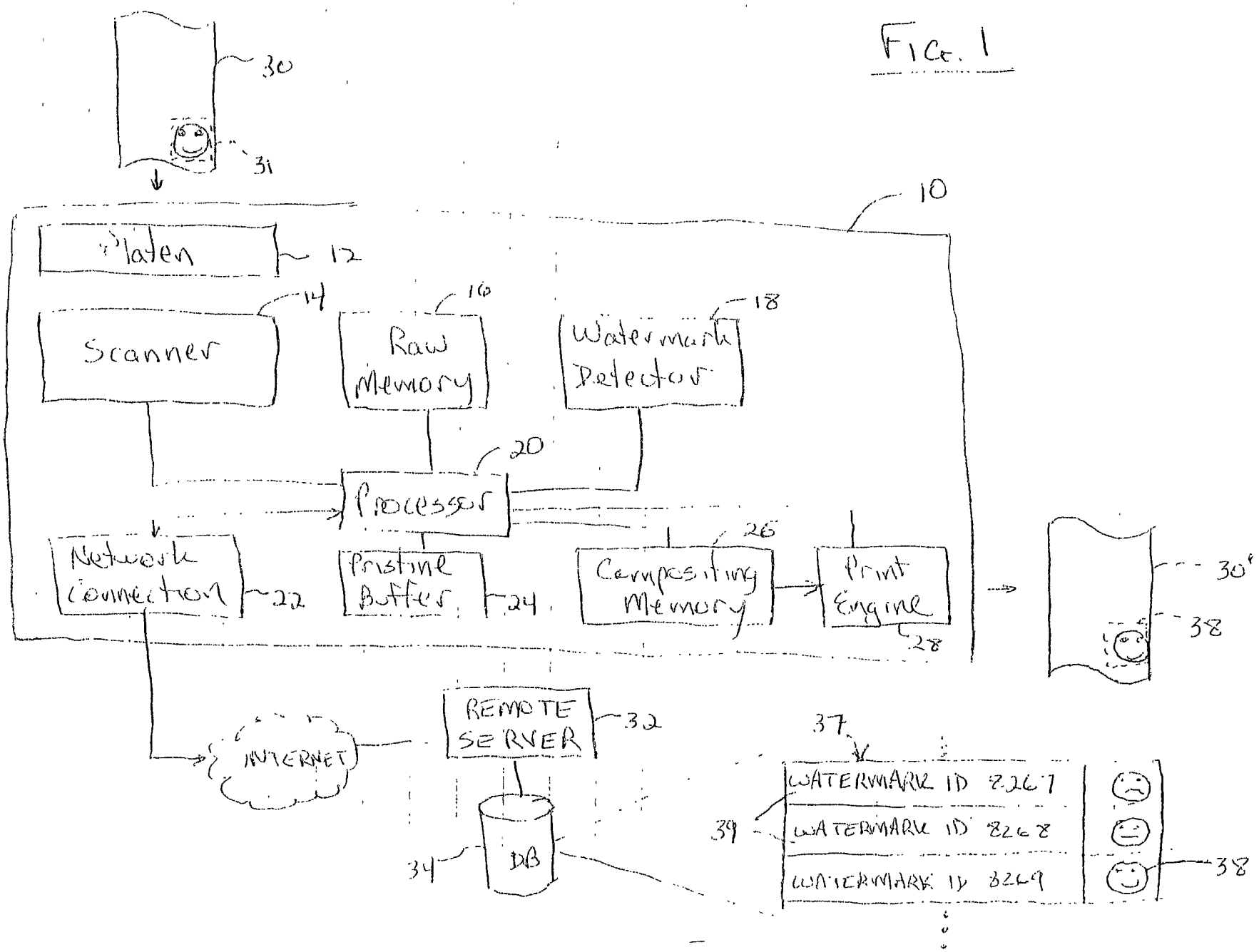
OLE-like principles are implemented using watermark data in digital objects in order to effect object linking or embedding. In one embodiment, a photocopier scans an original paper document to produce image data. This image data is analyzed for the presence of watermark data identifying a graphic on the document. With this watermark identifier, the photocopier can query a remote image database for pristine image data corresponding to the scanned graphic. This pristine data can be relayed from the remote database to the photocopier and substituted into the scanned image data. Output printed from the photocopier is thus based, at least in part, on pristine image data, rather than on image data that has been subjected to various corruption mechanisms (e.g., degradation of the original paper document, artifacts due to scanning, etc.). A "photocopy" better than the "original" can thereby be achieved.

WATERMARK-BASED PERSONAL AUDIO APPLIANCE

Abstract of the Disclosure

A portable device uses a microphone to listen to ambient audio, decodes a watermark signal therein, and uses the decoded data to request delivery of the audio or related information to the user's home or other location. The device is desirably pocket-sized, or suitable for carrying on a key-ring. The device may also detect a second watermark signal that is present in the user's environment (e.g., played through a public address speaker system) to aid the user in recalling the context from which the audio was requested.

FIG. 1



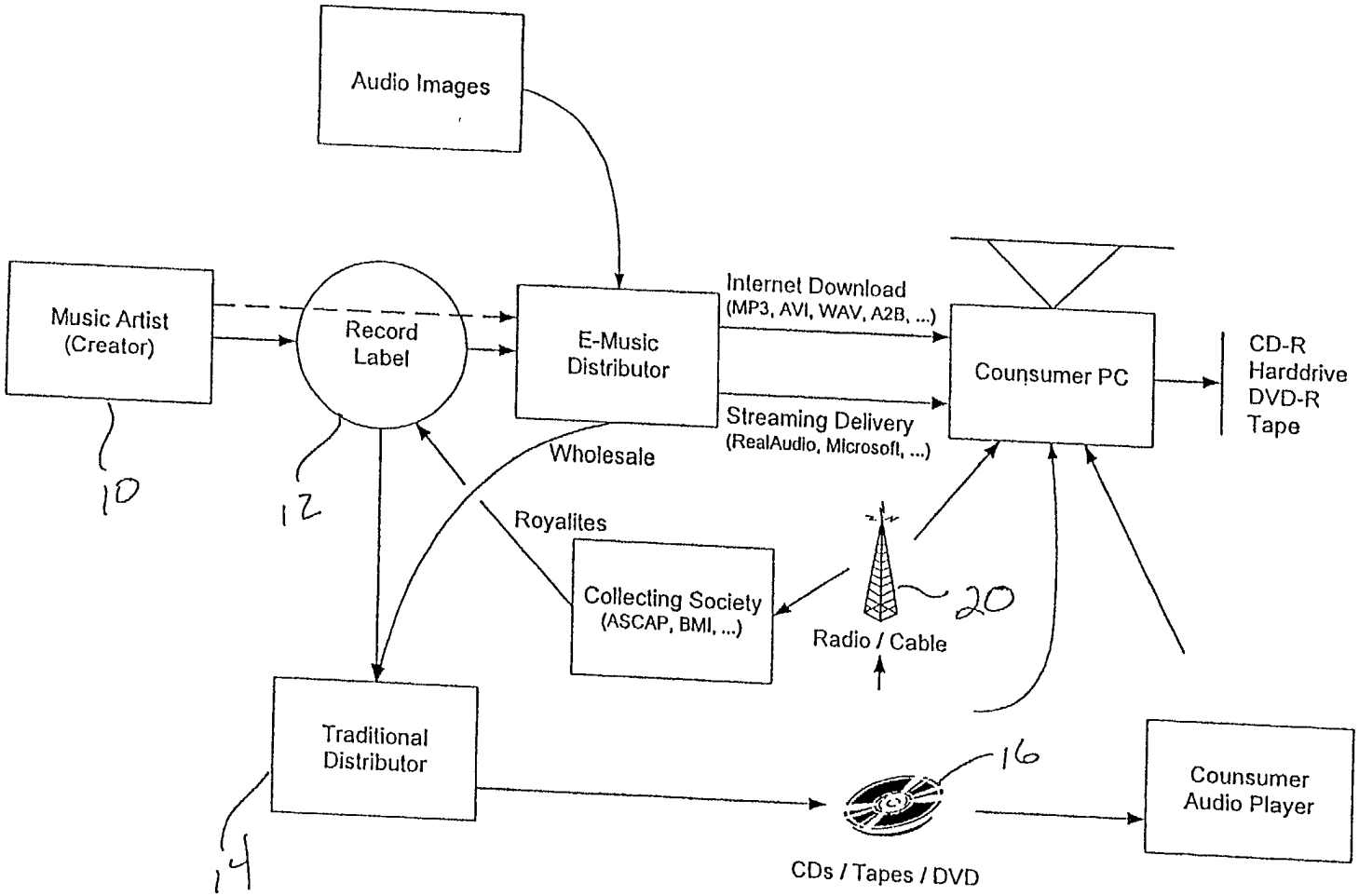


FIG. 1

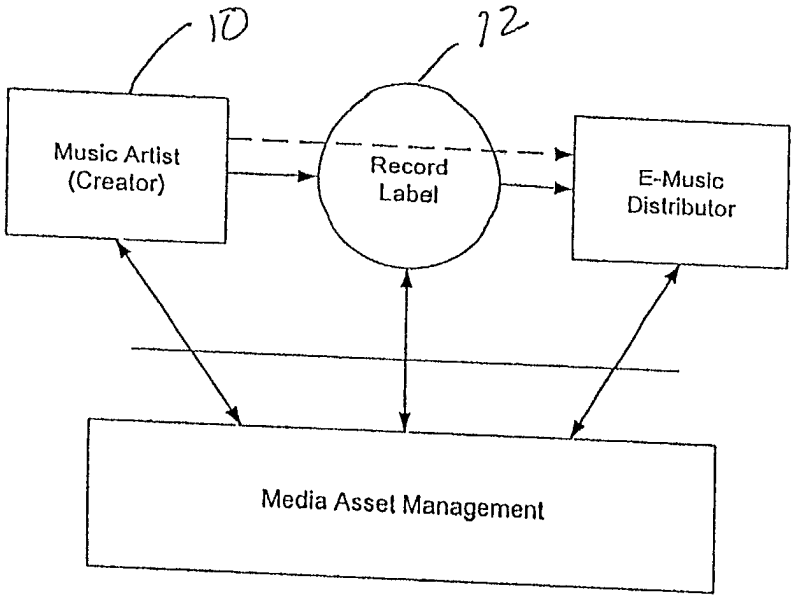


FIG. 2

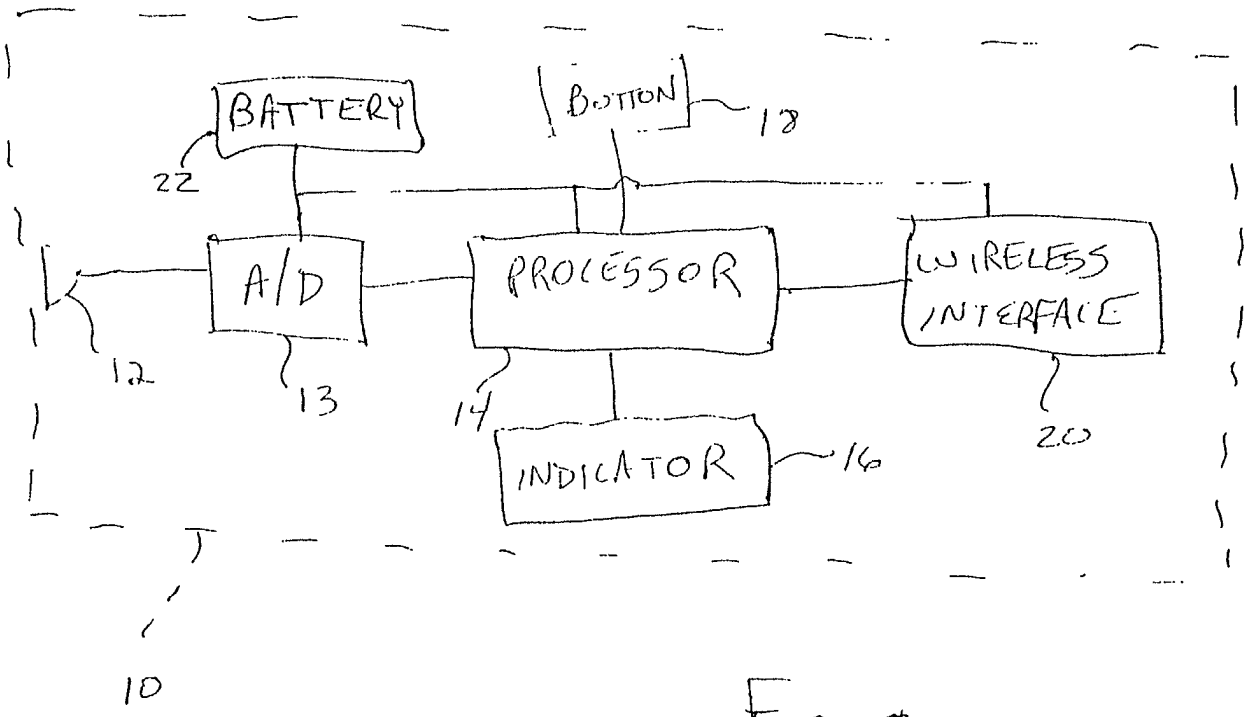


FIG. 3

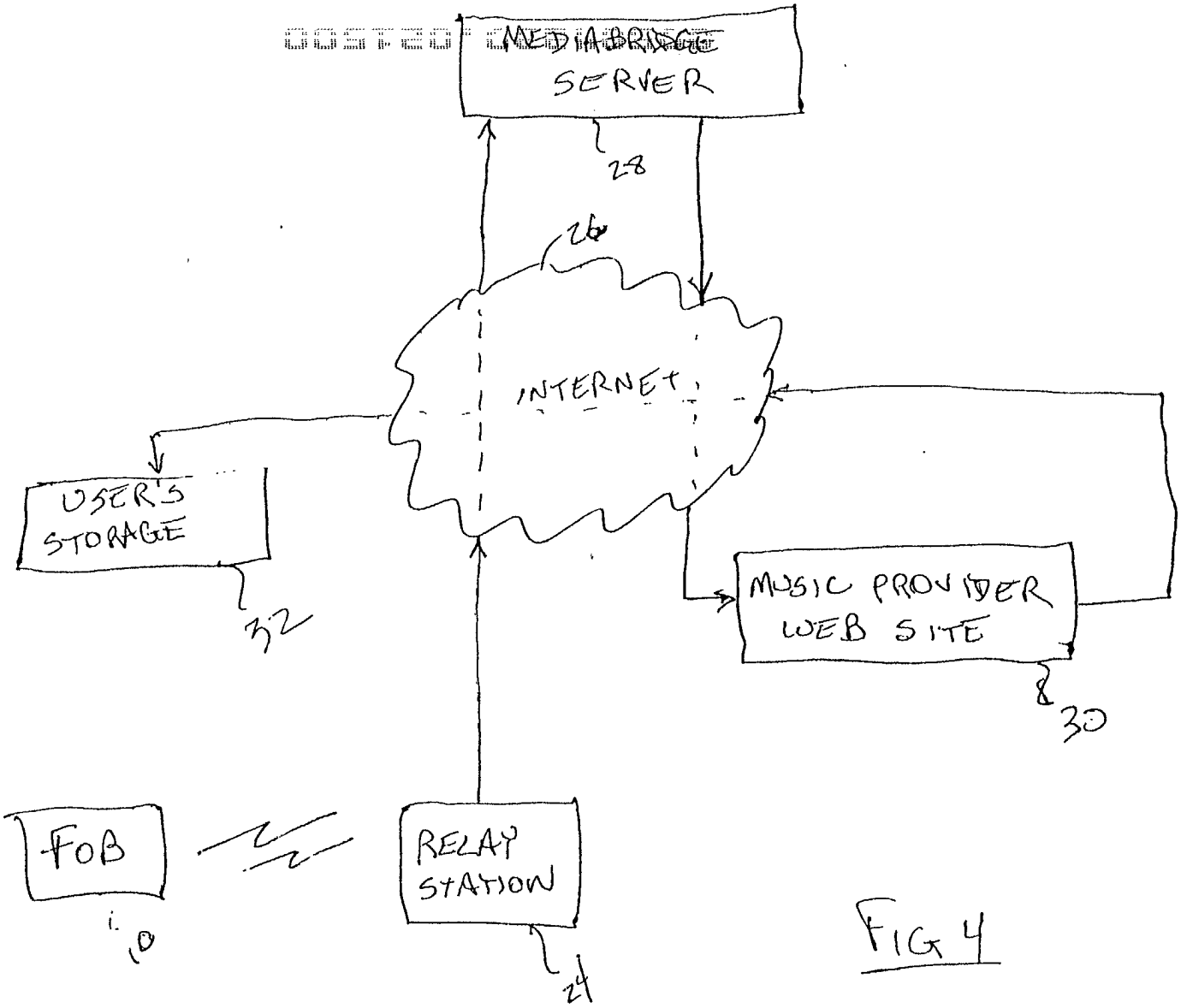

MEDIABRIDGE SERVER
28
26
INTERNET
USER'S STORAGE
32
MUSIC PROVIDER WEB SITE
30
FOB
10
RELAY STATION
24

FIG 4

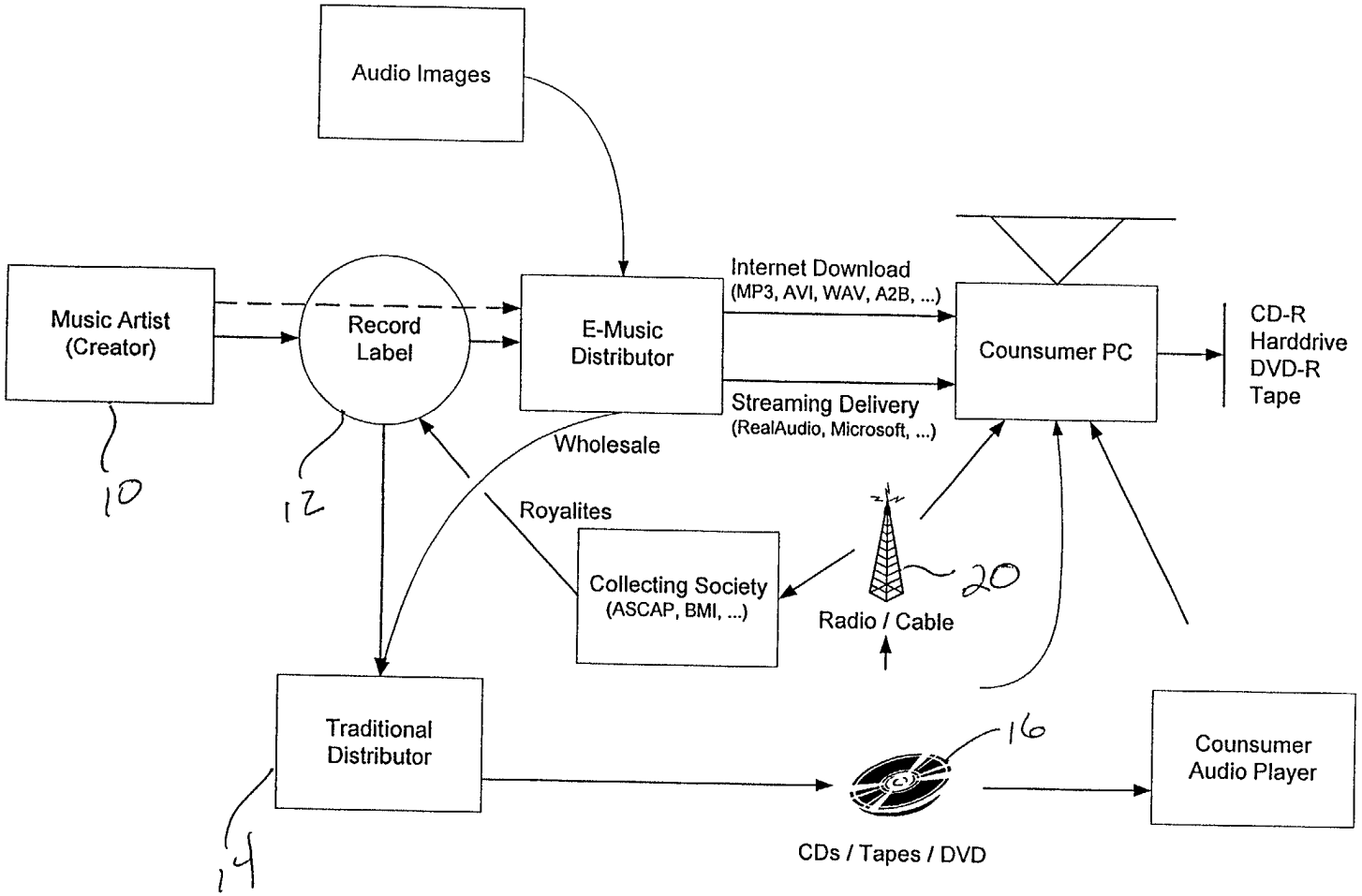

Audio Images
Music Artist
(Creator)
Record
Label
E-Music
Distributor
Internet Download
(MP3, AVI, WAV, A2B, ...)
Streaming Delivery
(RealAudio, Microsoft, ...)
Counsumer PC
CD-R
Harddrive
DVD-R
Tape
Wholesale
Royalites
Collecting Society
(ASCAP, BMI, ...)
Radio / Cable
20
10
12
Traditional
Distributor
14
16
Counsumer
Audio Player
CDs / Tapes / DVD

FIG. 1

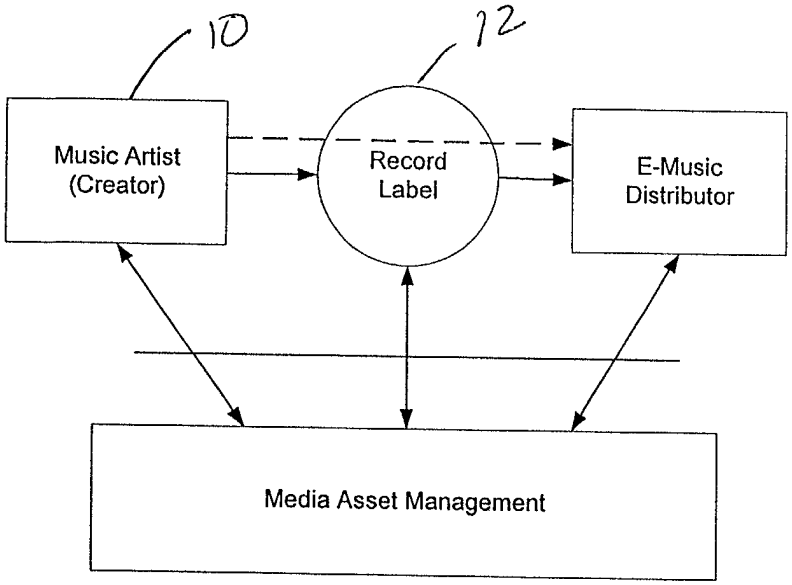

10
12
Music Artist
(Creator)
Record
Label
E-Music
Distributor
Media Asset Management

FIG. 2

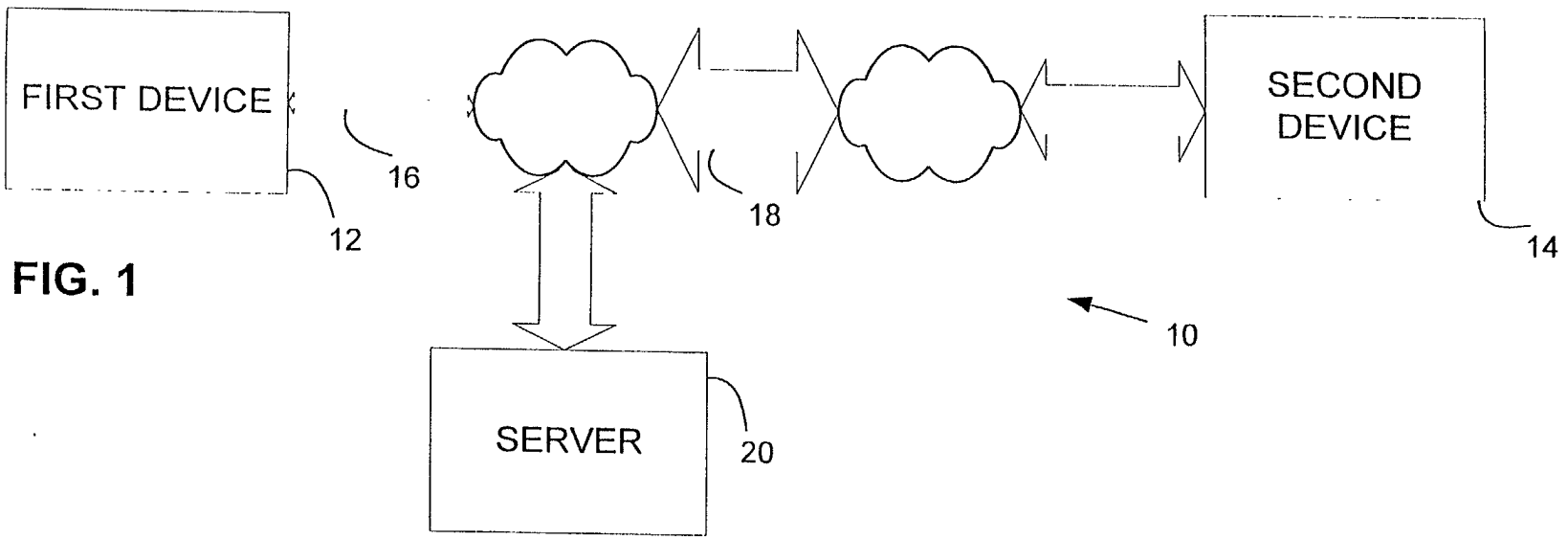


FIG. 1

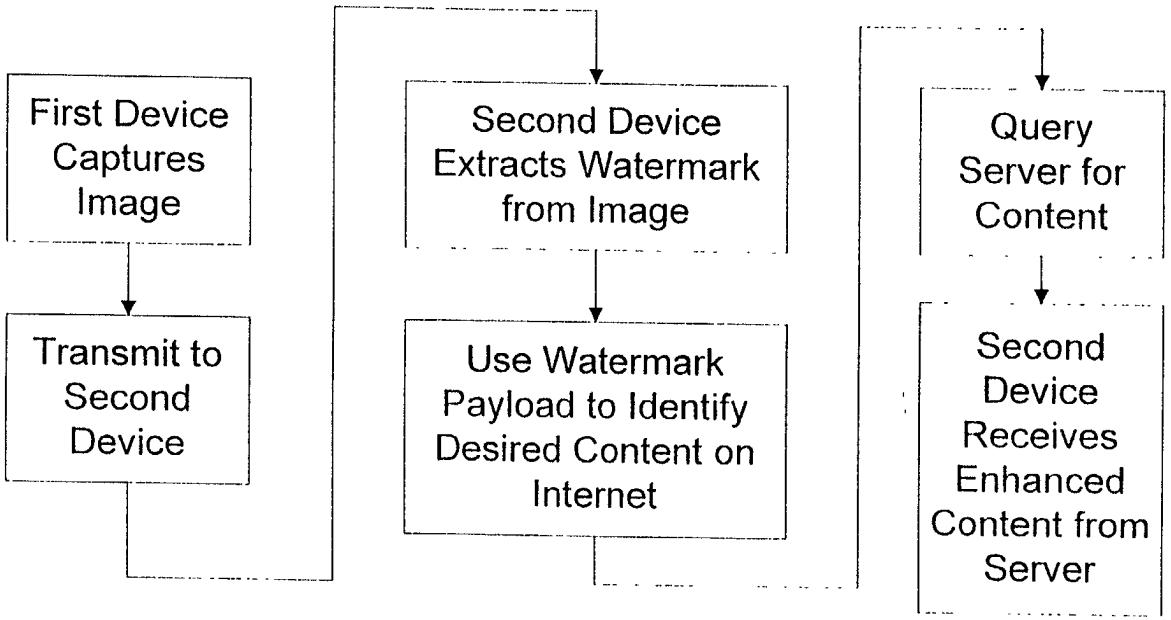


FIG. 2

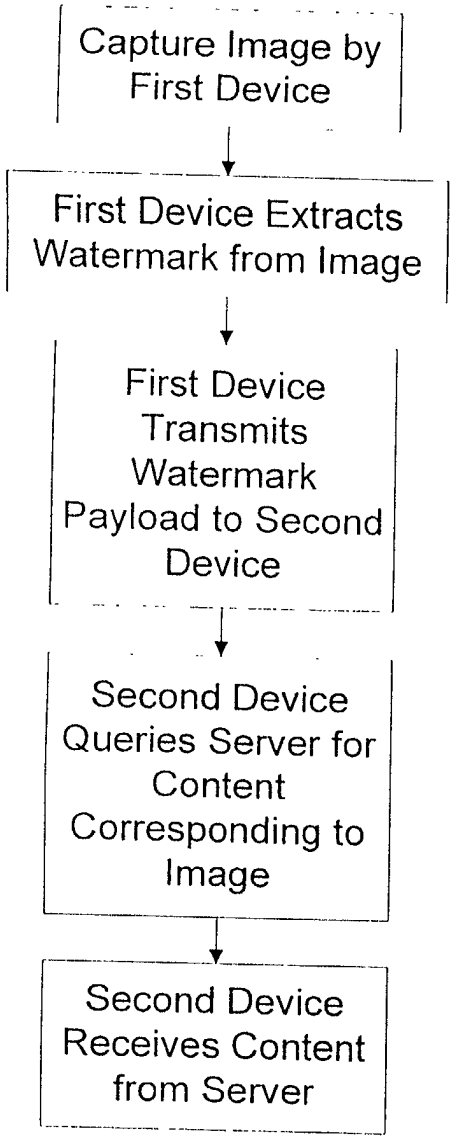


FIG. 3

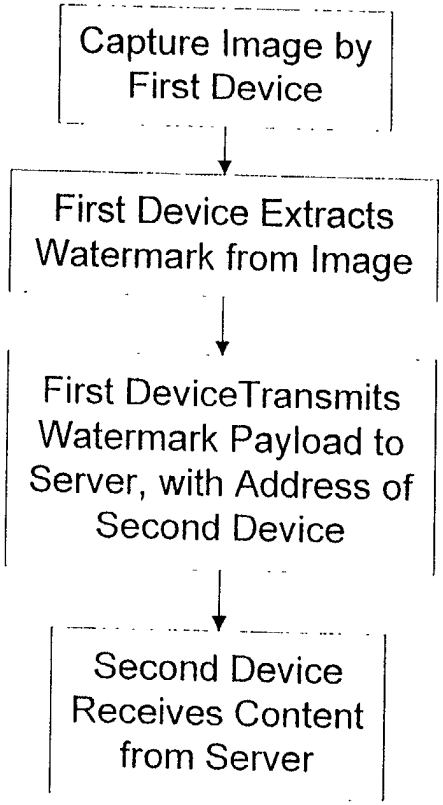


FIG. 4

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled DATA TRANSMISSION BY WATERMARK PROXY, the specification of which

[x] is attached hereto.

[ ] was filed on _____ as Application No. _____.

[ ] was described and claimed in PCT International Application No. _____, filed on _____, and as amended under PCT Article 19 on _____ (if applicable).

[ ] and was amended on _____ (if applicable).

[ ] with amendments through _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56. If this is a continuation-in-part application filed under the conditions specified in 35 U.S.C. § 120 which discloses and claims subject matter in addition to that disclosed in the prior copending application, I further acknowledge the duty to disclose material information as defined in 37 CFR § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT International application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes	[ ] No

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

60/134,782	May 19, 1999
Application Number	Filing Date

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or § 365(c) of any PCT International application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT International filing date of this application:

Data Transmission by Watermark Proxy (Atty Ref. 60099)	1/26/00	Pending
09/473,396	12/28/99	Pending
09/476,686	12/30/99	Pending
(Application No.)	(Filing Date)	(Status: patented, Pending, abandoned)

The undersigned hereby authorizes the U.S. attorney or agent named herein to accept and follow instructions from _____ as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney or agent and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorney or agent named herein will be so notified by the undersigned.

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application, to file a corresponding international application, and to transact all business in the Patent and Trademark Office connected therewith:

William Y. Conwell	Reg. No. 31,943
Joel R. Meyer	Reg. No. 37,677
Thomas M. Horgan	Reg. No. 33,183
Elmer Galbi	Reg. No. 19,761

Address all telephone calls to William Y. Conwell at telephone number (503) 968-0443.
Address all correspondence to:

William Y. Conwell
Digimarc Corporation
19801 SW 72nd Avenue, Suite 250
Tualatin, OR 97062

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor: Bruce L. Davis

Inventor's Signature _____ _____
Date

Residence: Lake Oswego, Oregon

Citizenship: USA

Post Office Address: 15599 Village Drive, Lake Oswego, OR 97034

Full Name of Second Joint Inventor: William Y. Conwell

Inventor's Signature _____ _____
Date

Residence: Portland, Oregon

Citizenship: USA

Post Office Address: 6224 SW Tower Way, Portland, OR 97221